Acceptance of Inclusive Events Kinematics Seen Differently

Education/Primer Material

Thomas Ullrich

December 8, 2015

BROOKHAVEN
NATIONAL LABORATORY

How it was done

- All events were generated with PYTHIA6 wrapped in TPythia and run as stand-alone programs.
- All settings are identical to the standard Pythia6 as described on the EIC Wiki
- In what follows only the kinematics of the scattered electron is studied
- The histograms are none standard ROOT histos and were edited with Illustrator
- They are all available as eps/pdf

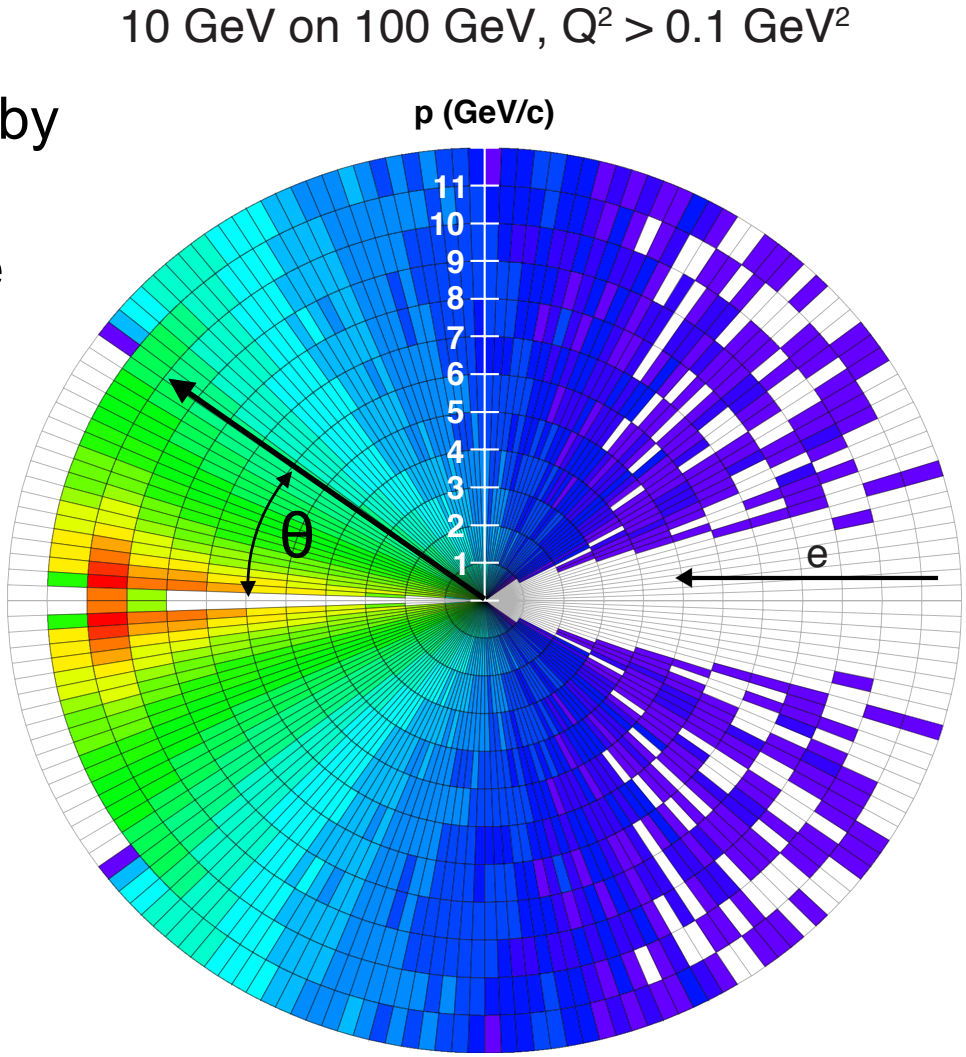
What is plotted?

Scattered Electron: θ and p

The momentum, p, is reflected by the distance from the origin.

The further away the higher the momentum.

The colZ scale is log and reflects the magnitude of the cross-section

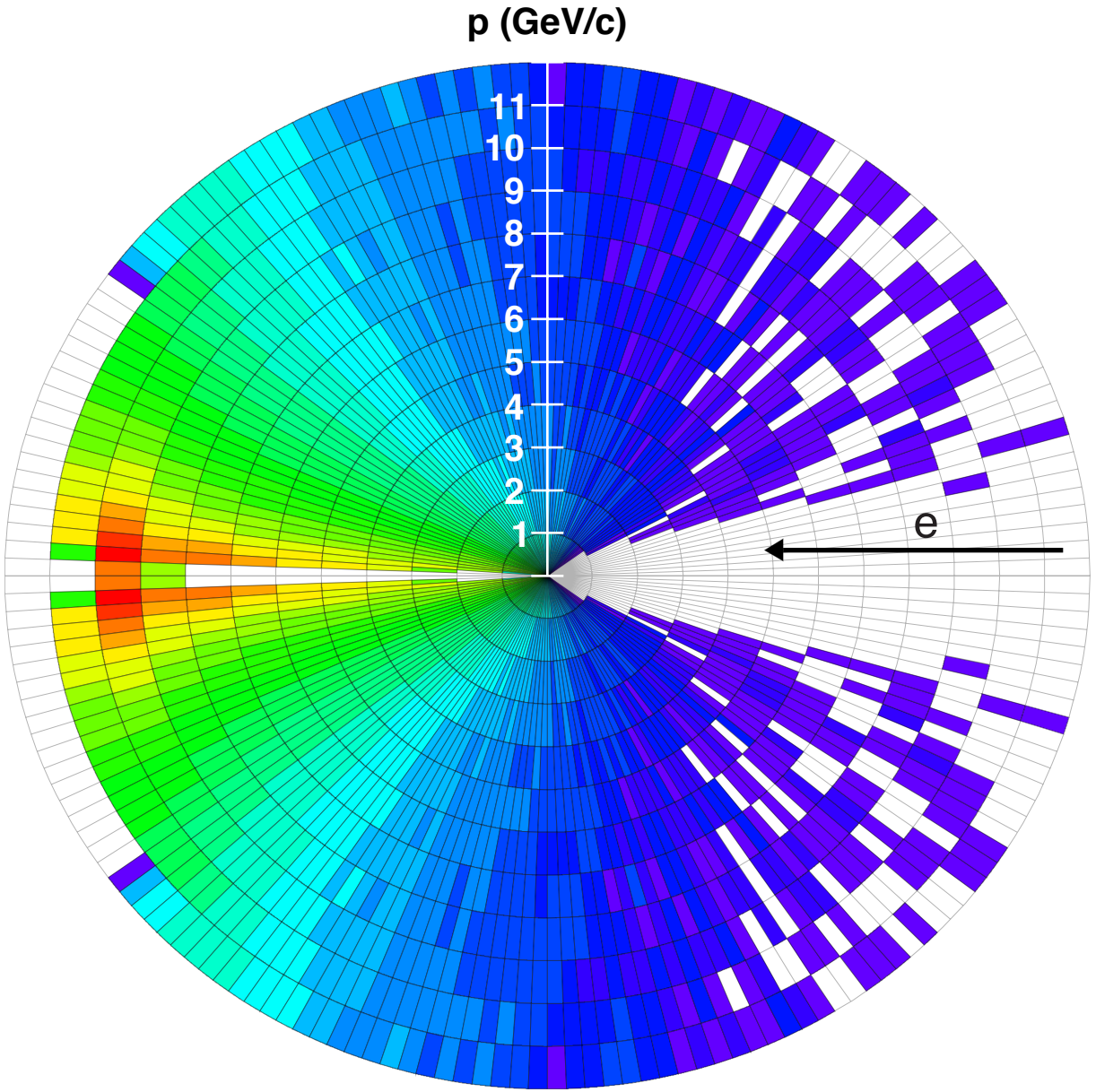


Animation 1

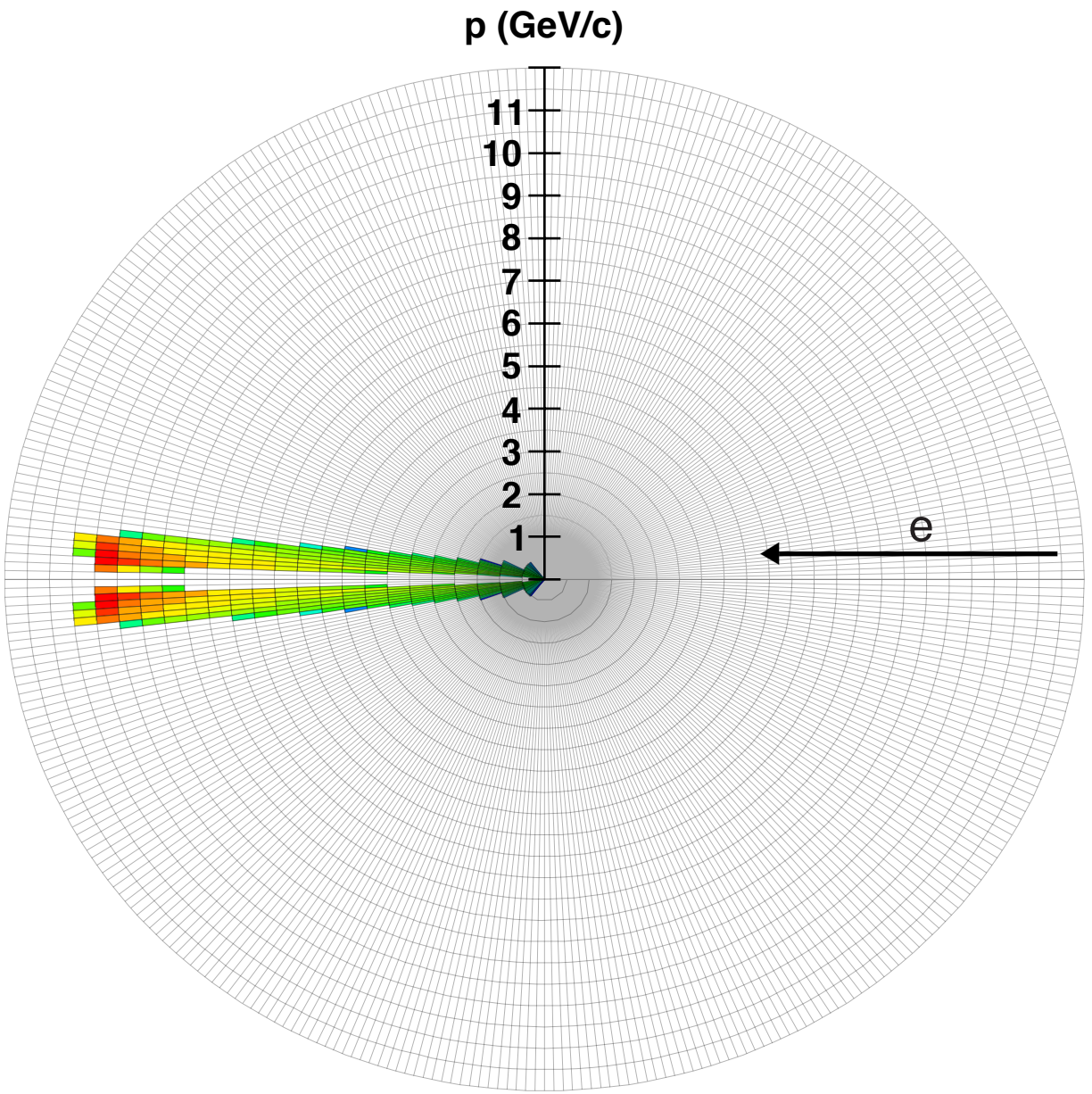
At the same energy vary Q^2

Demonstrates: the importance of forward region for low Q^2 and the importance for low p acceptance at mid rapidity. For large Q^2 the barrel and even the backwards (hadron going) region matters for the electron

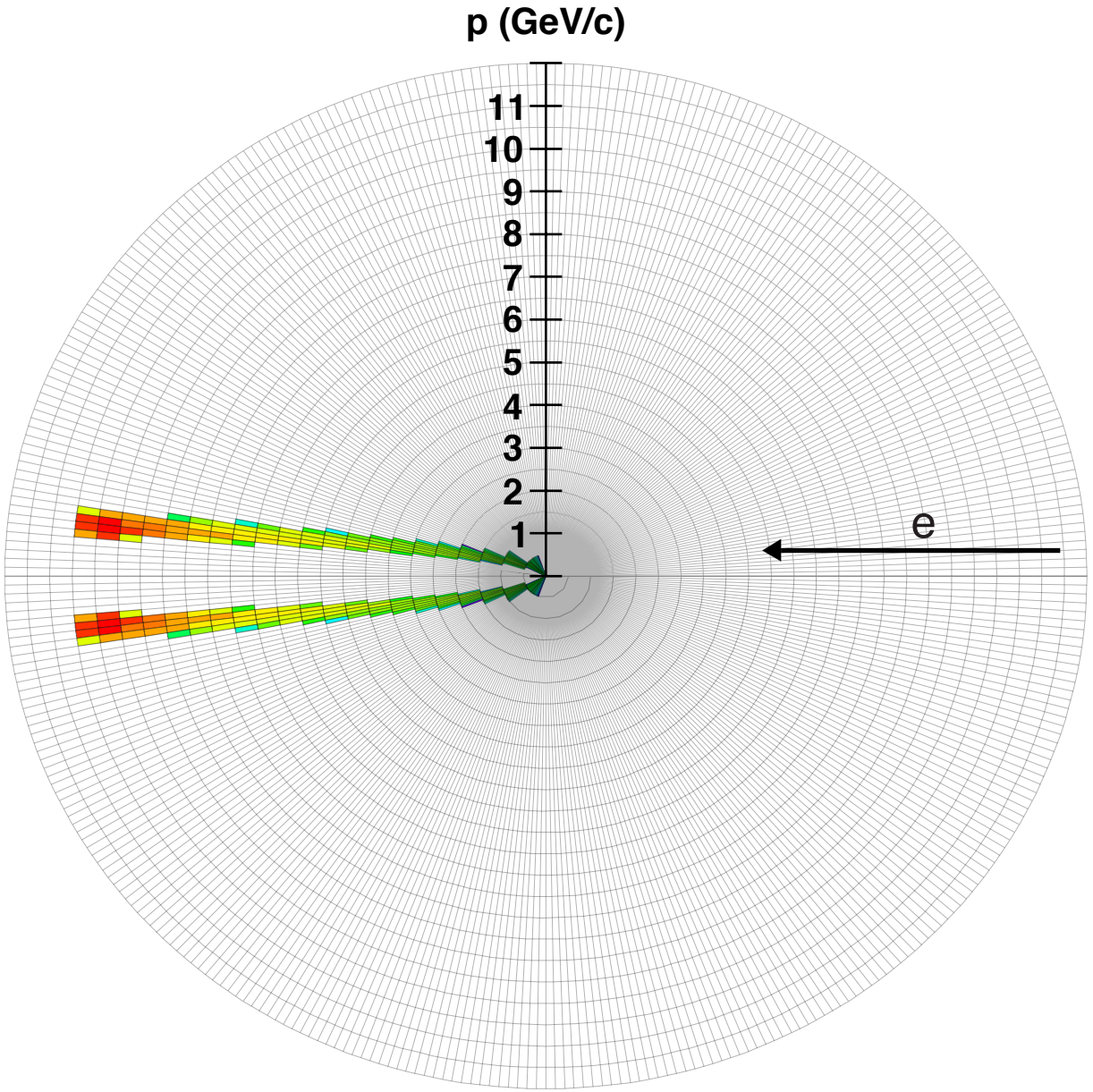
10 GeV on 100 GeV, $Q^2 > 0.1$ GeV^2



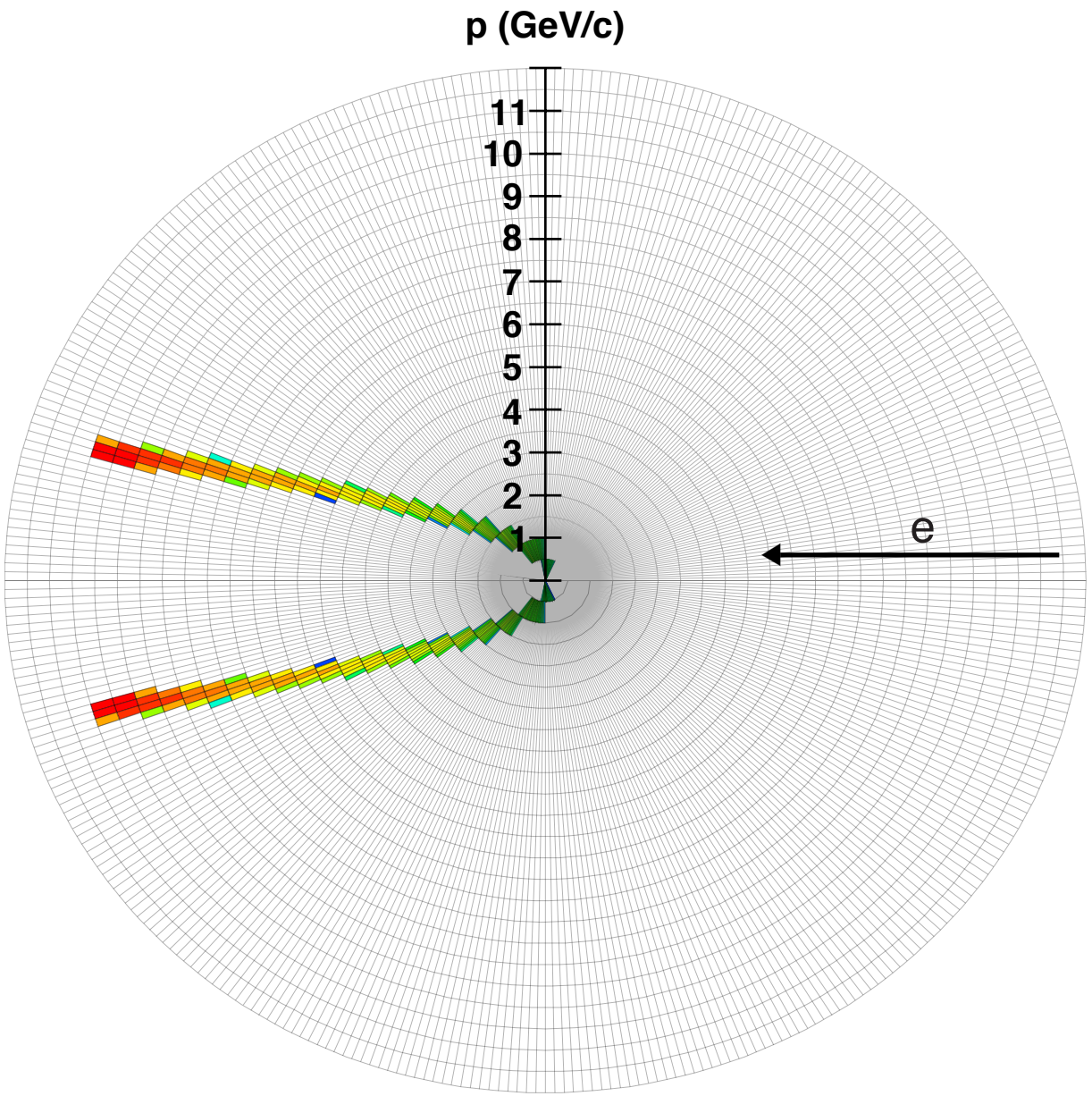
10 GeV on 100 GeV, $0.1 < Q^2 < 1$ GeV^2



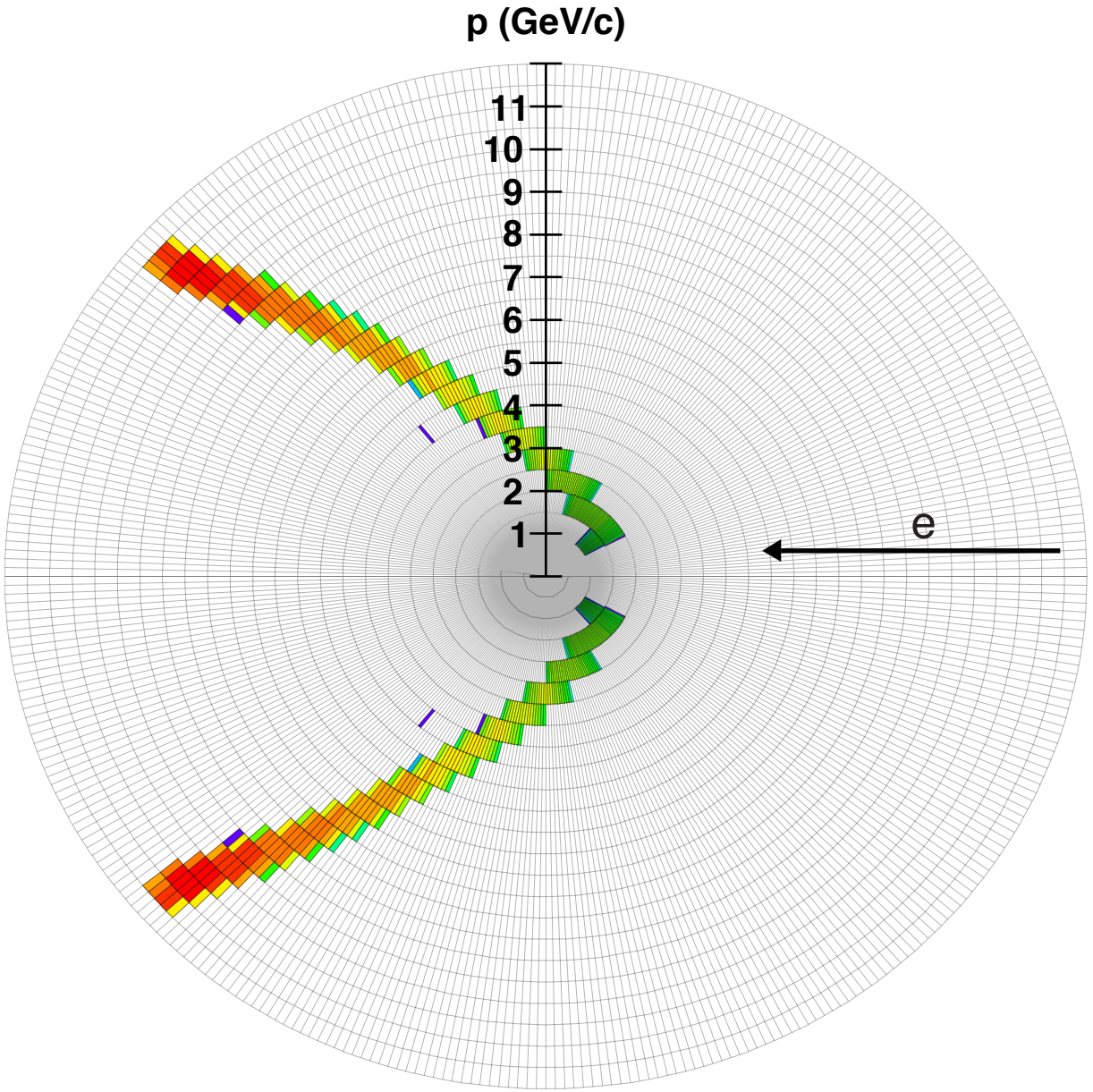
10 GeV on 100 GeV, $1 < Q^2 < 2$ GeV^2



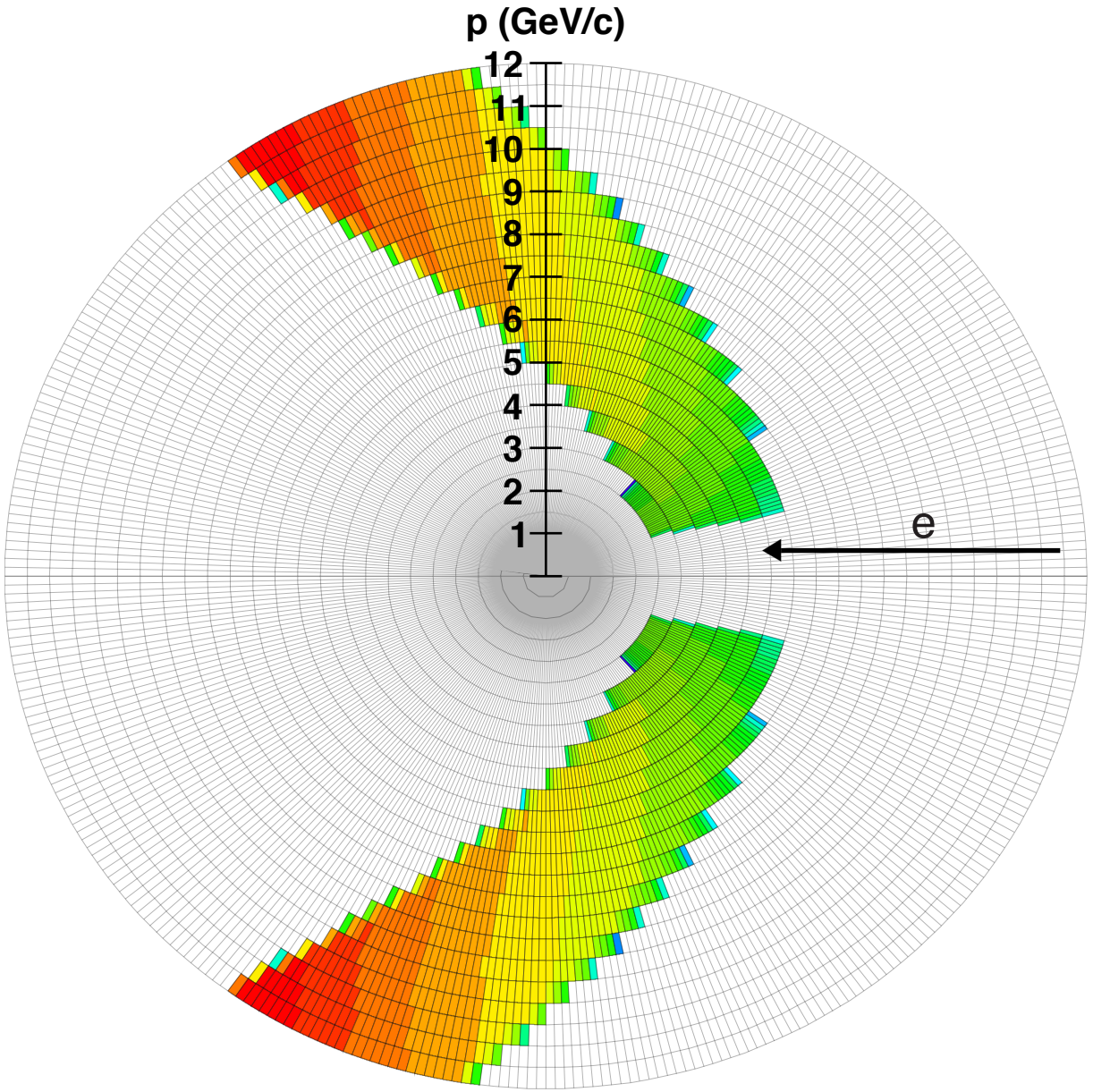
10 GeV on 100 GeV, $8 < Q^2 < 10$ GeV^2



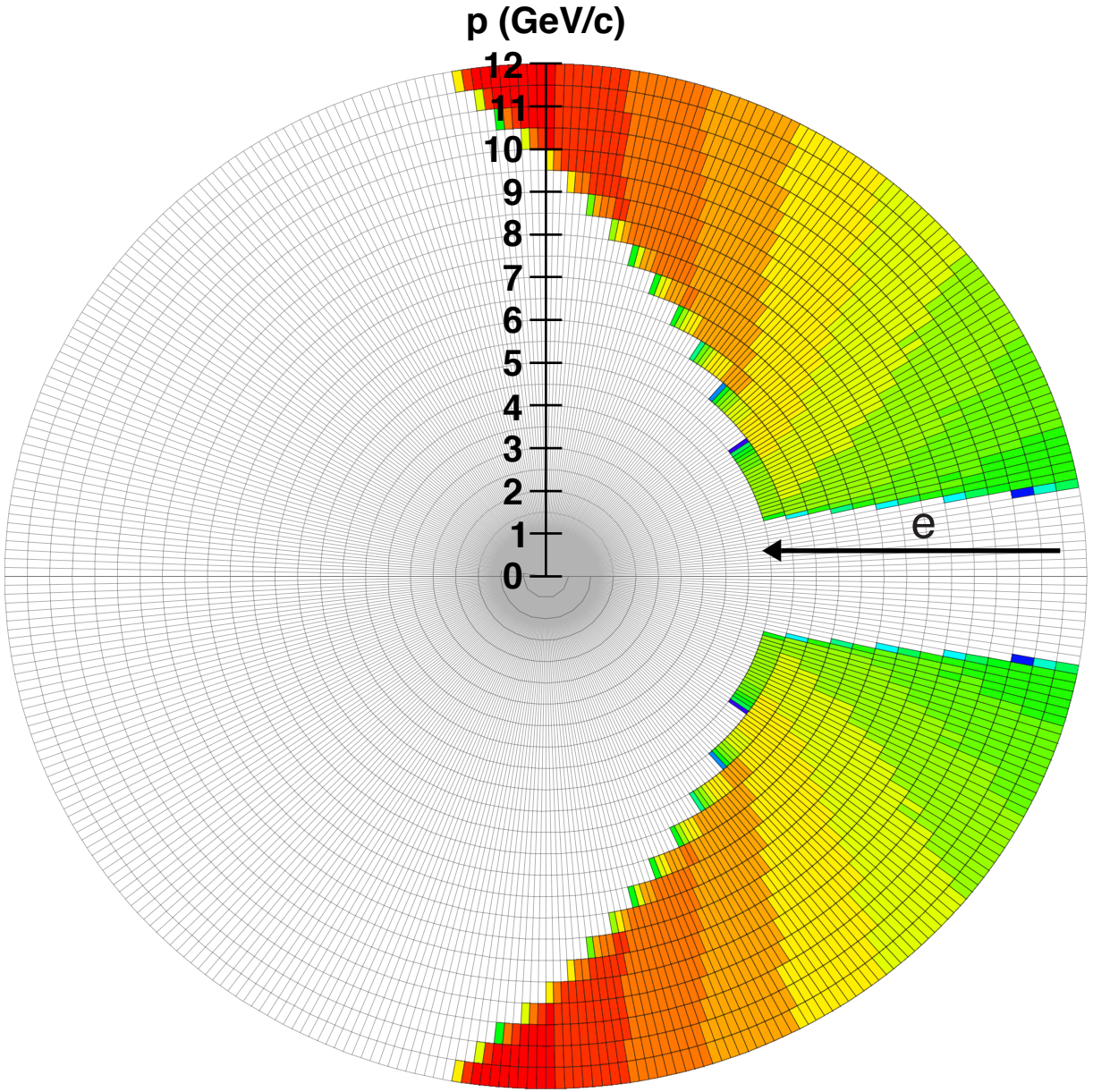
10 GeV on 100 GeV, $50 < Q^2 < 60$ GeV^2



10 GeV on 100 GeV, $100 < Q^2 < 200\ GeV^2$



10 GeV on 100 GeV, $Q^2 > 200\ GeV^2$

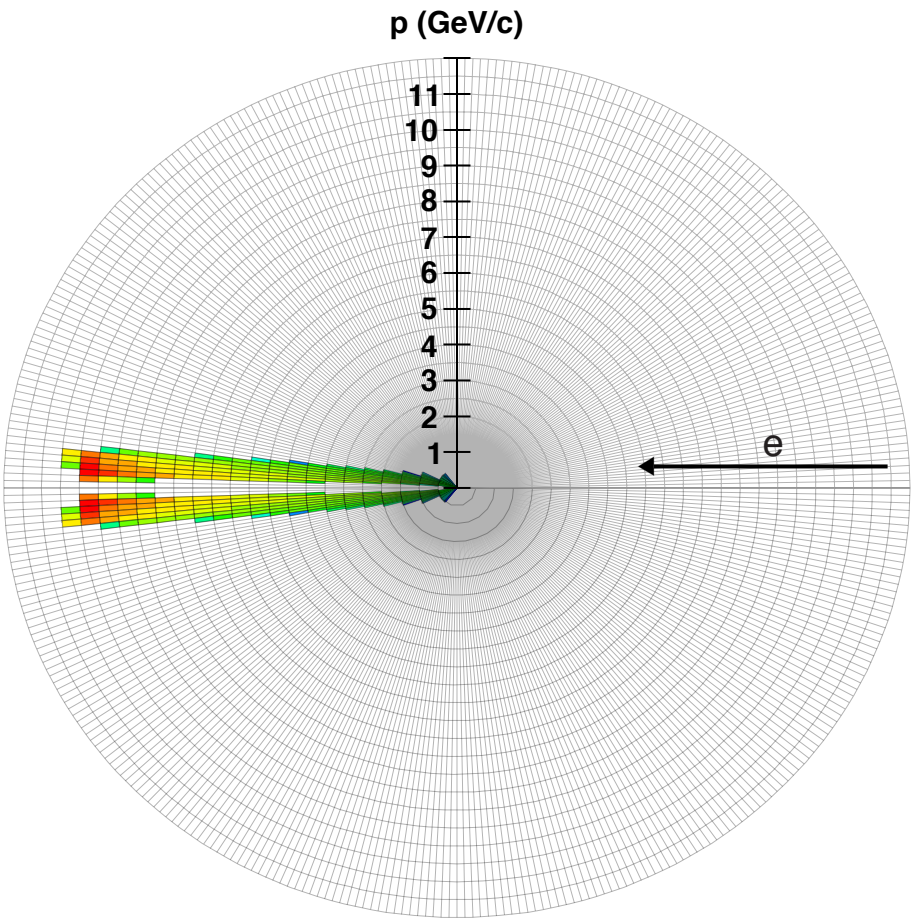


Animation 2

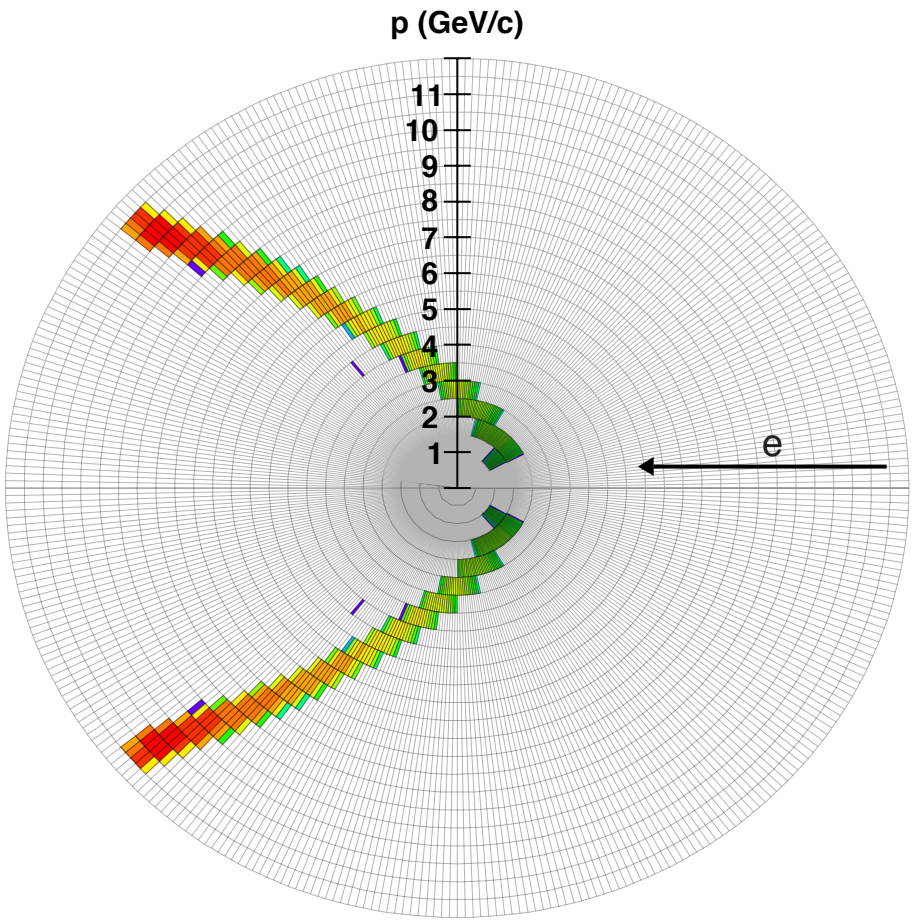
At the same Q^2 (two bins) vary beam energies

Demonstrates: Higher e Energy drives the electron more forward, lower towards the barrel. Lowering hadron beam energy has surprisingly small effect.

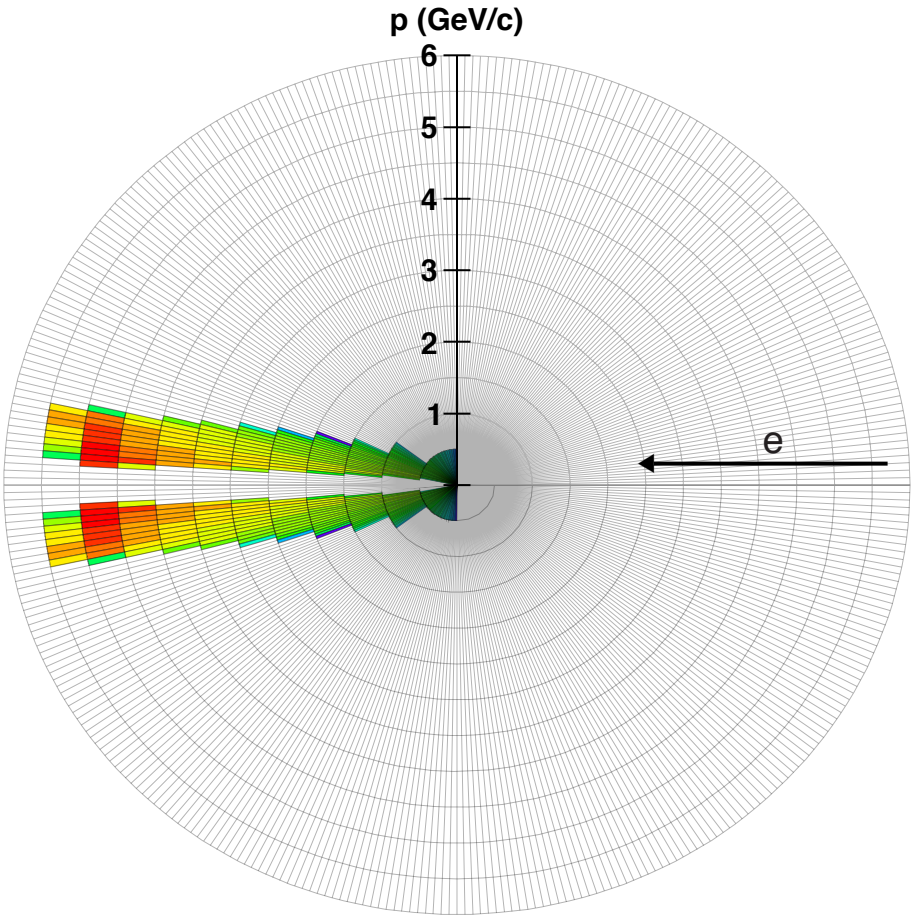
10 GeV on 100 GeV, $0.1 < Q^2 < 1$ GeV^2



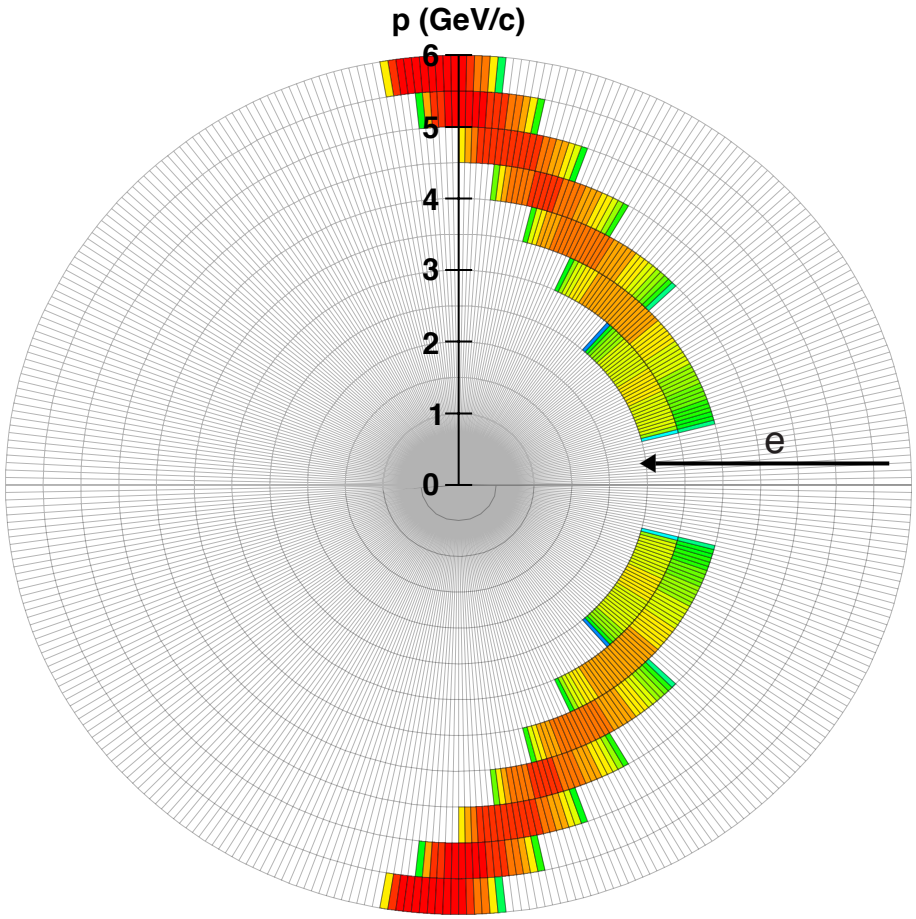
10 GeV on 100 GeV, $50 < Q^2 < 60$ GeV^2



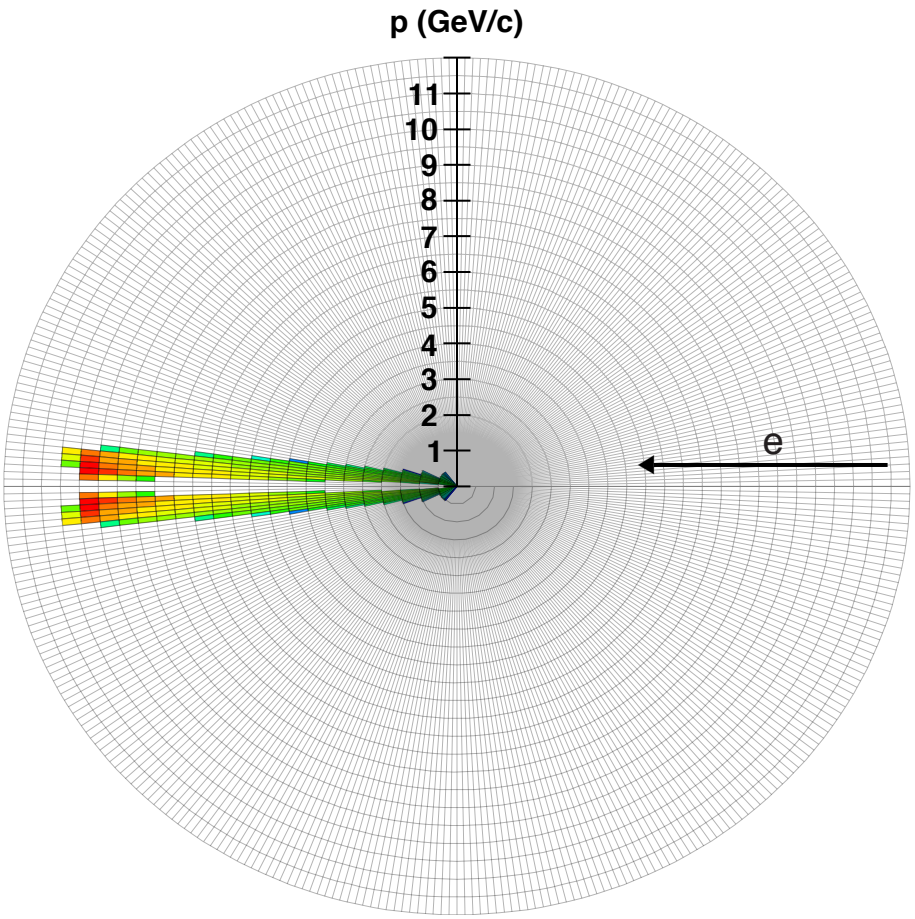
5 GeV on 100 GeV, $0.1 < Q^2 < 1$ GeV^2



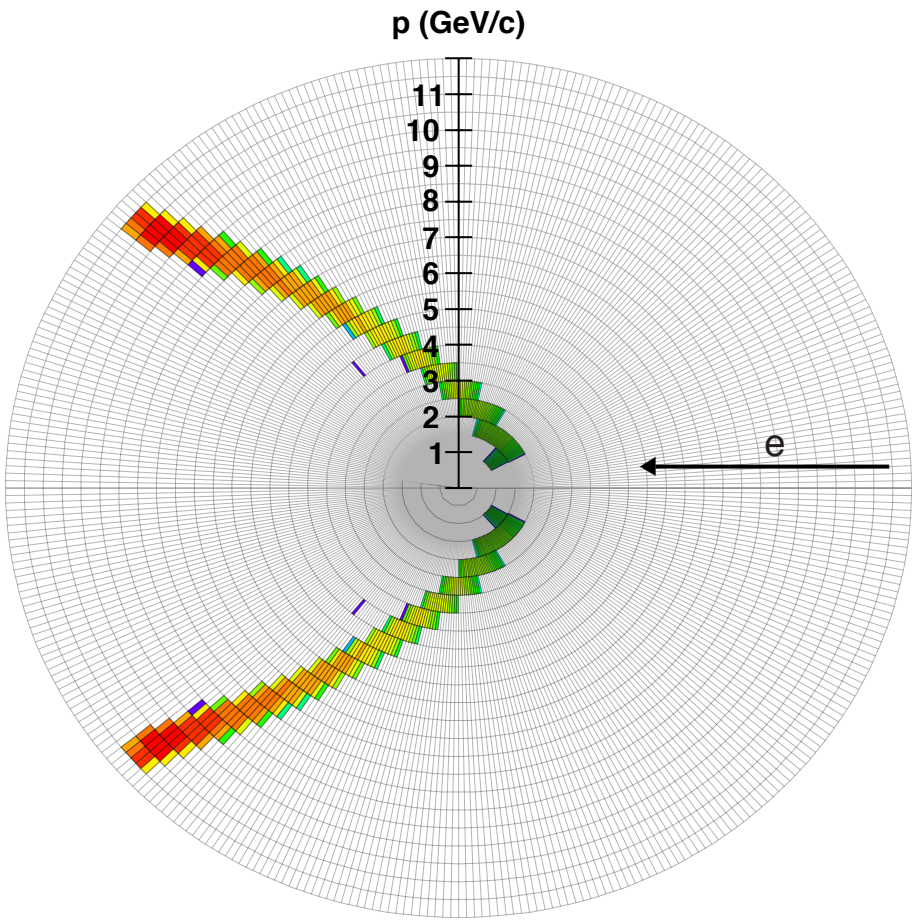
5 GeV on 100 GeV, $50 < Q^2 < 60$ GeV^2



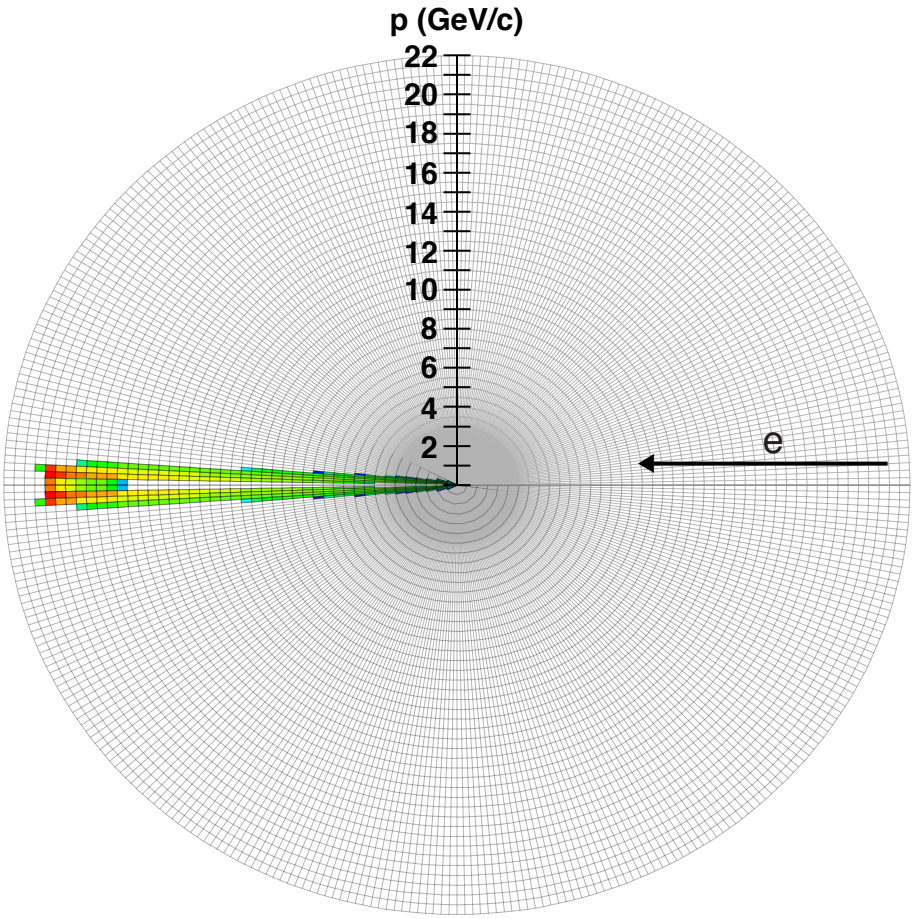
10 GeV on 100 GeV, $0.1 < Q^2 < 1$ GeV^2



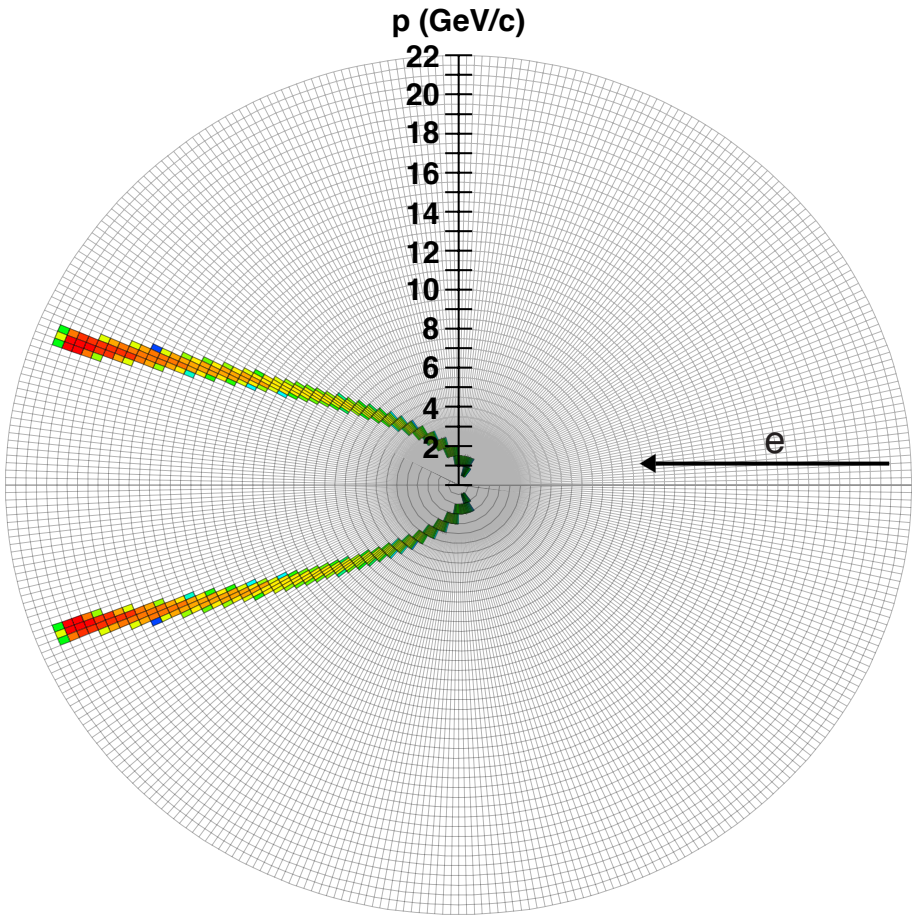
10 GeV on 100 GeV, $50 < Q^2 < 60$ GeV^2



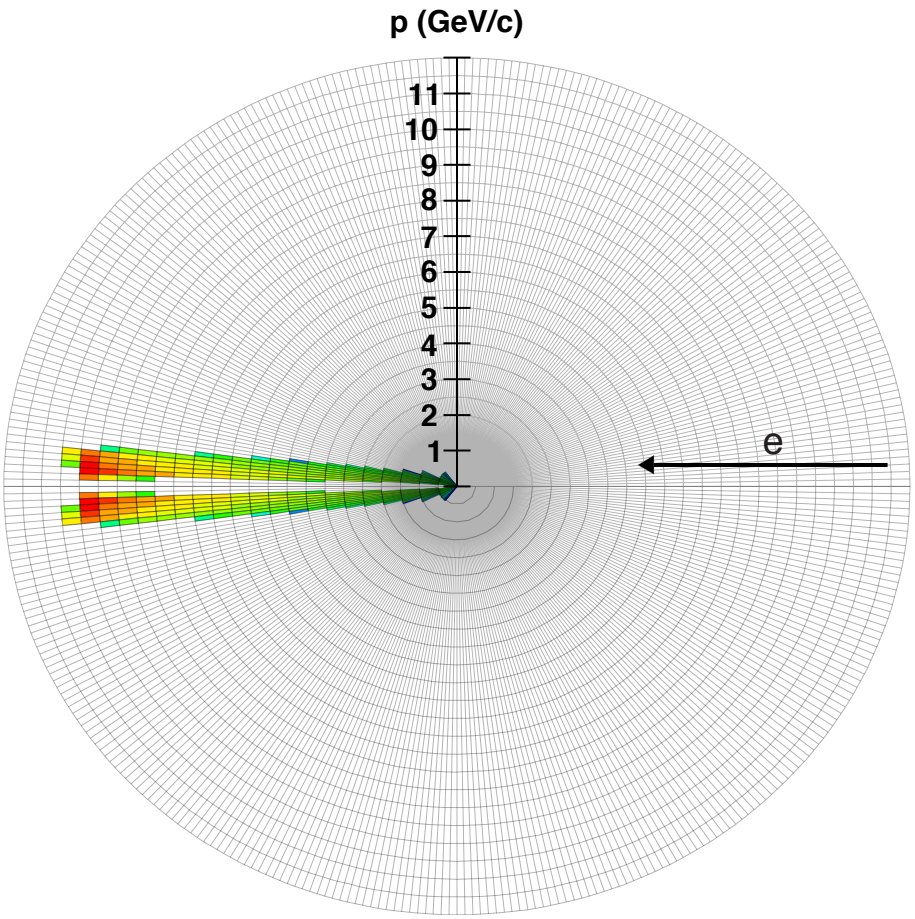
20 GeV on 100 GeV, $0.1 < Q^2 < 1$ GeV^2



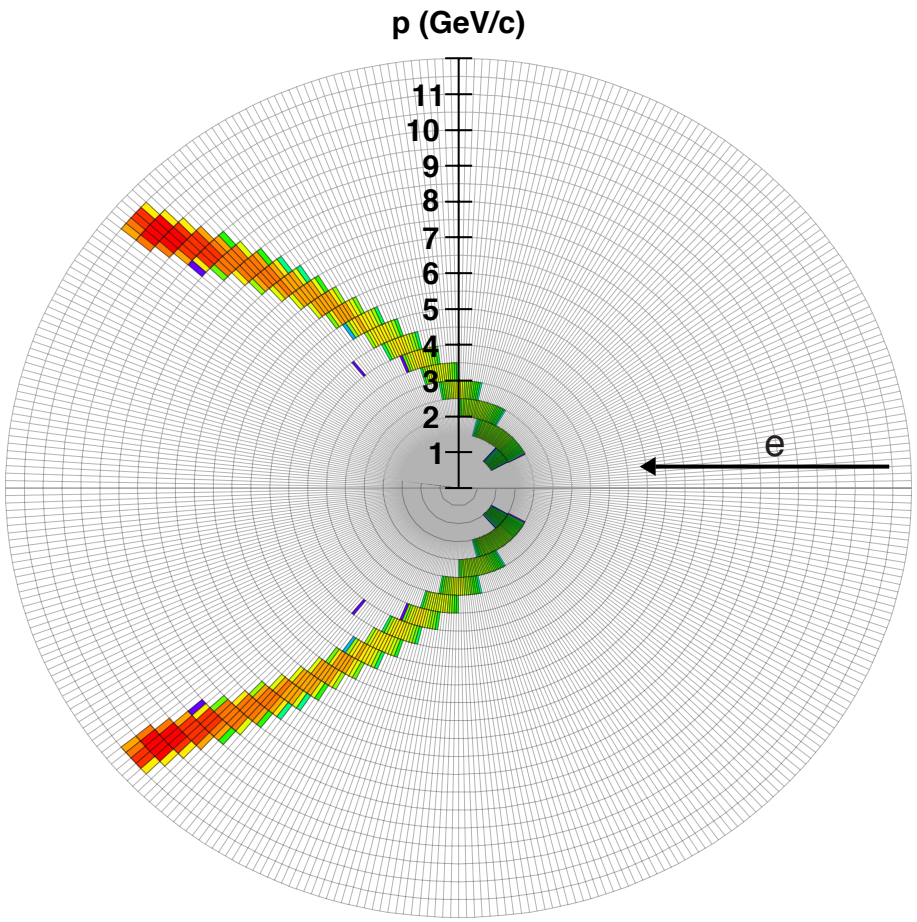
20 GeV on 100 GeV, $50 < Q^2 < 60$ GeV^2



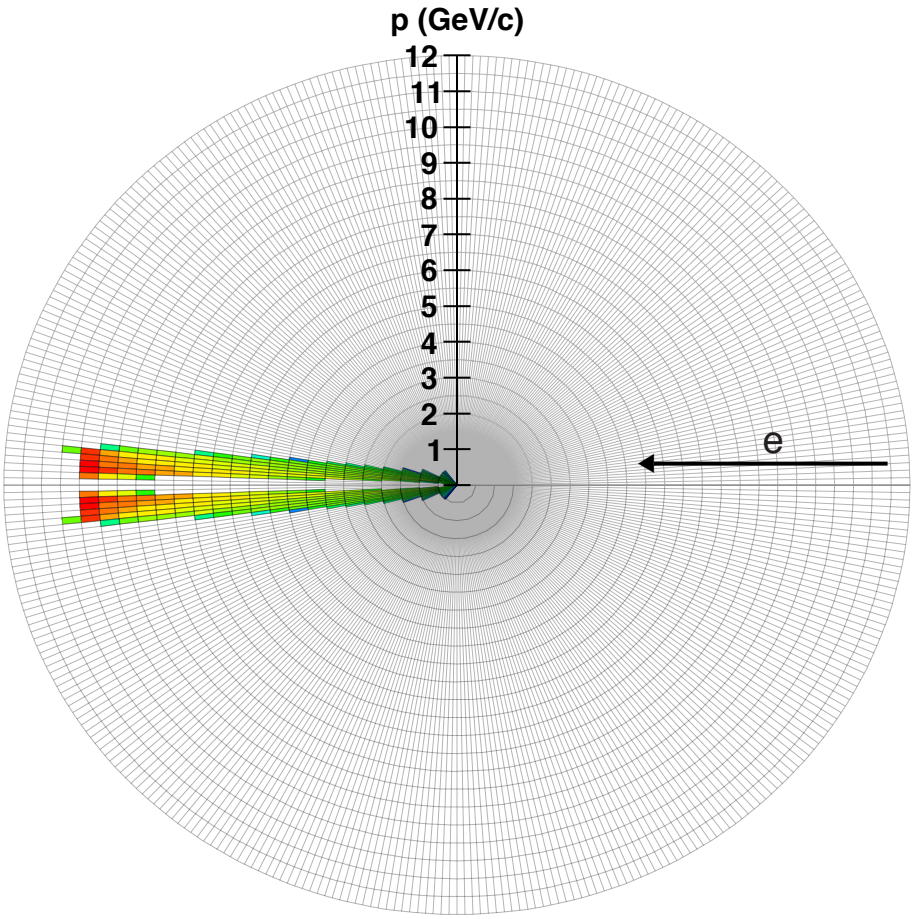
10 GeV on 100 GeV, $0.1 < Q^2 < 1$ GeV^2



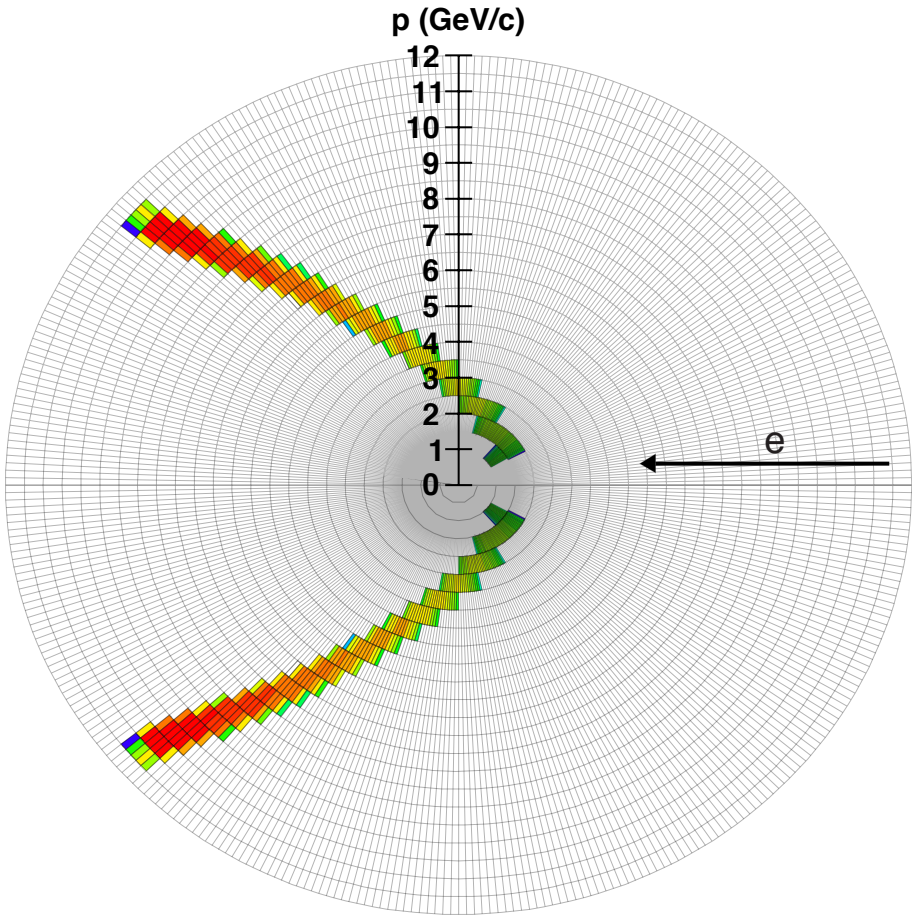
10 GeV on 100 GeV, $50 < Q^2 < 60$ GeV^2



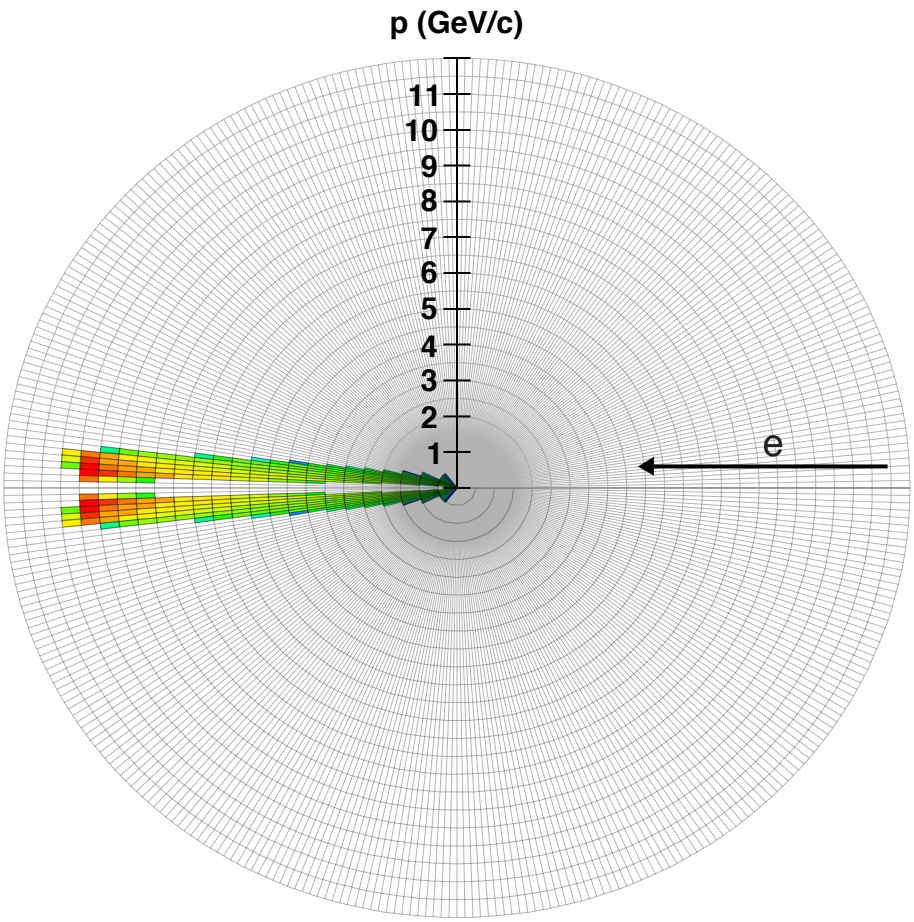
10 GeV on 50 GeV, $0.1 < Q^2 < 1$ GeV^2



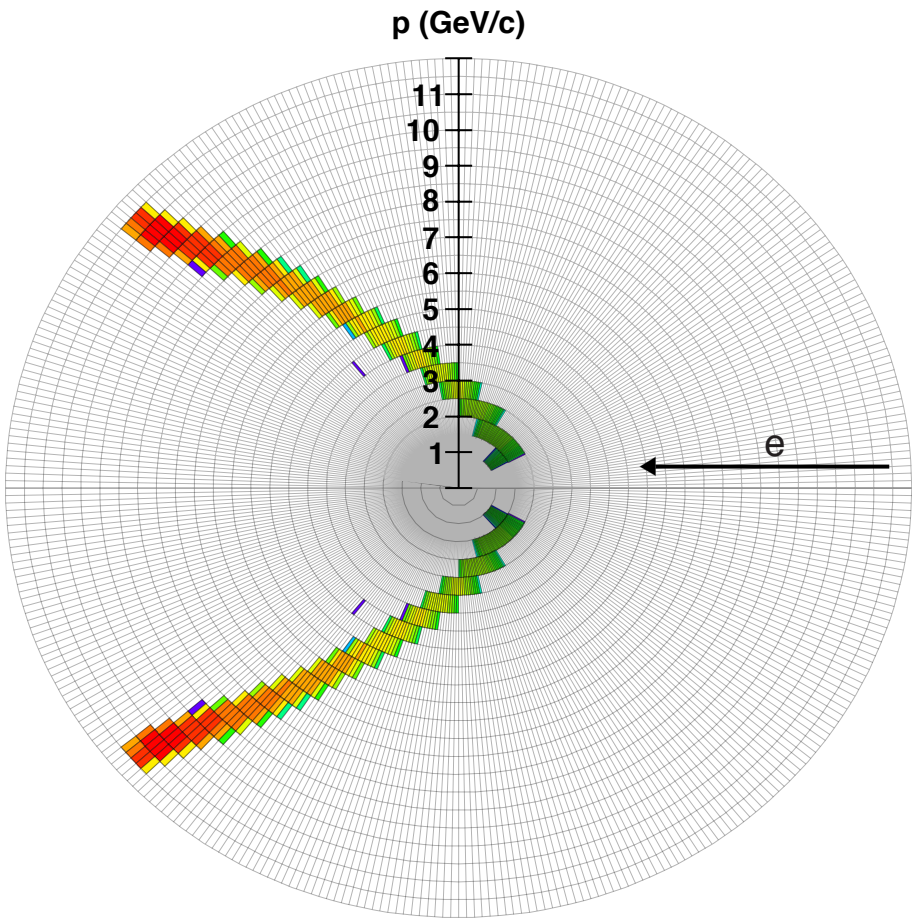
10 GeV on 50 GeV, $50 < Q^2 < 60$ GeV^2



10 GeV on 100 GeV, $0.1 < Q^2 < 1$ GeV^2



10 GeV on 100 GeV, $50 < Q^2 < 60$ GeV^2

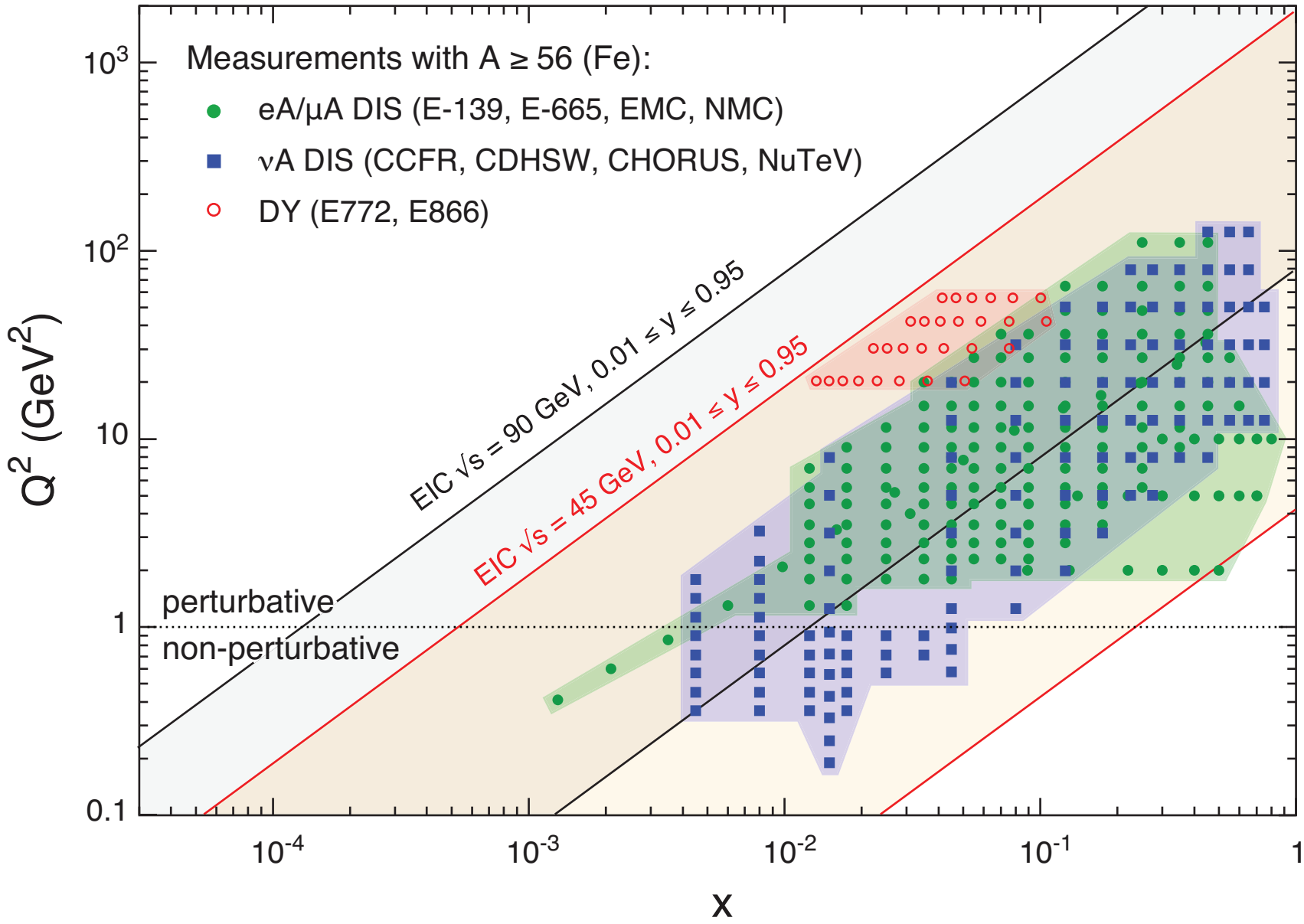


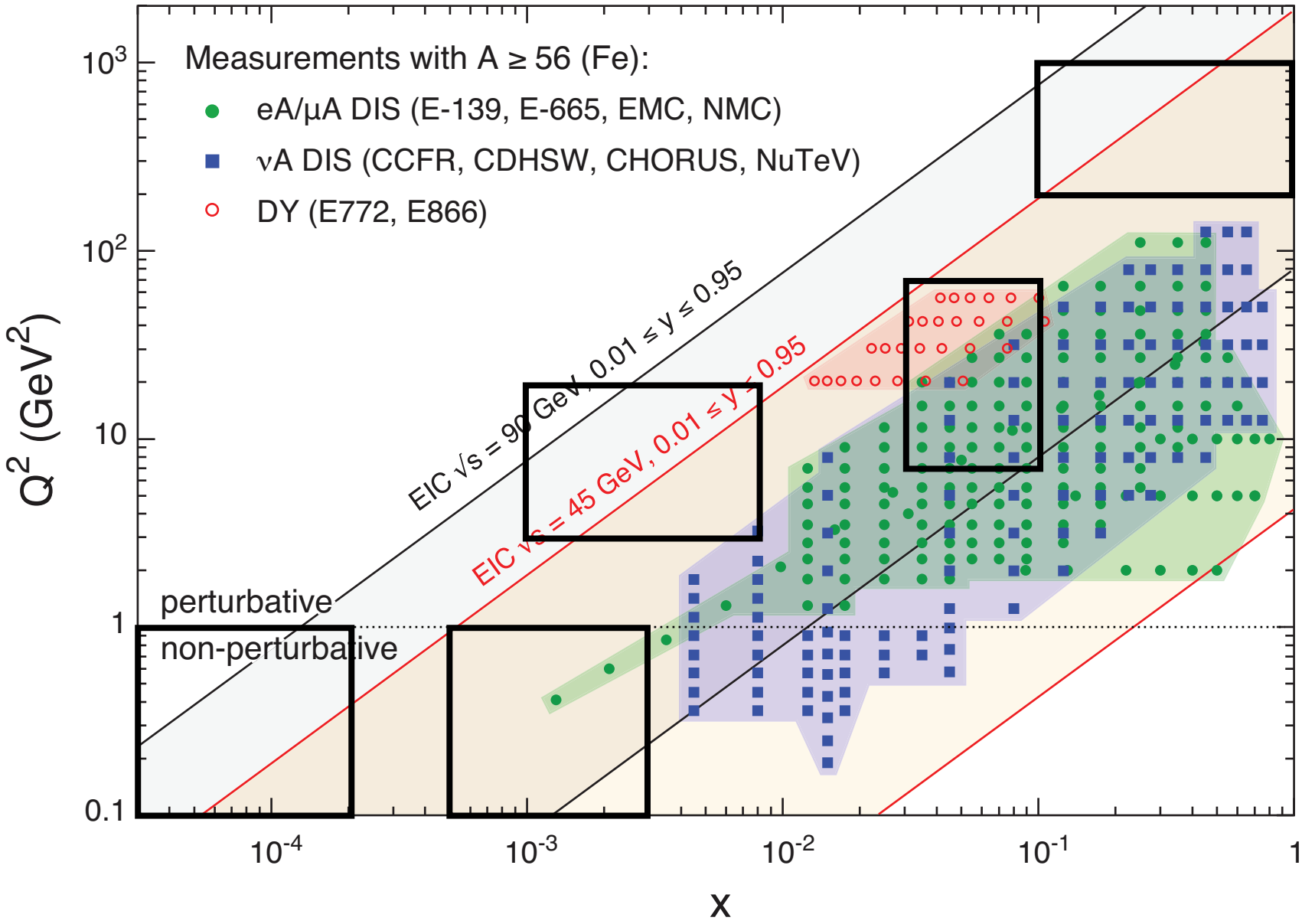
Animation 3

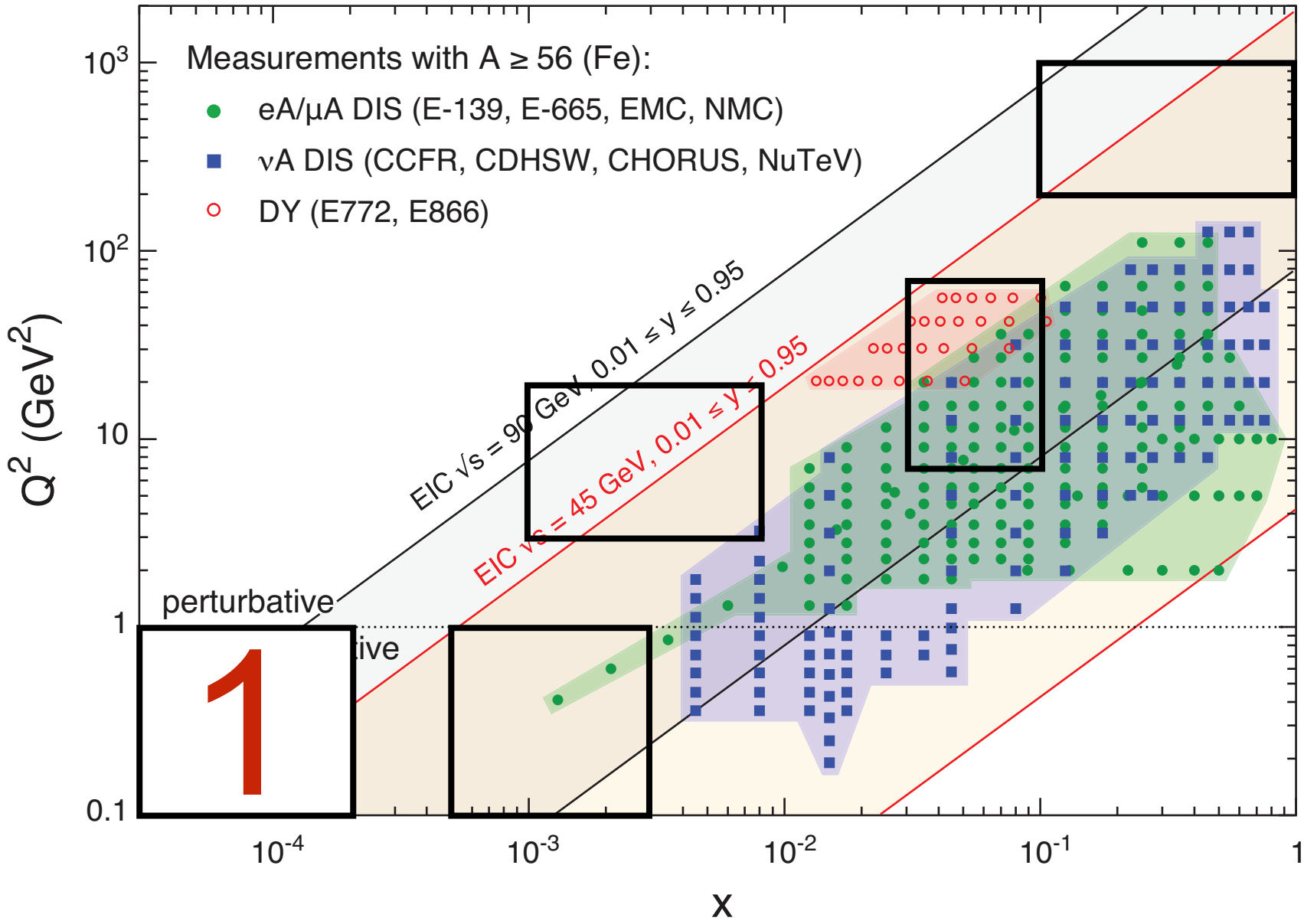
Exploring the x-Q^2 plane

What regions of interest mean kinematically

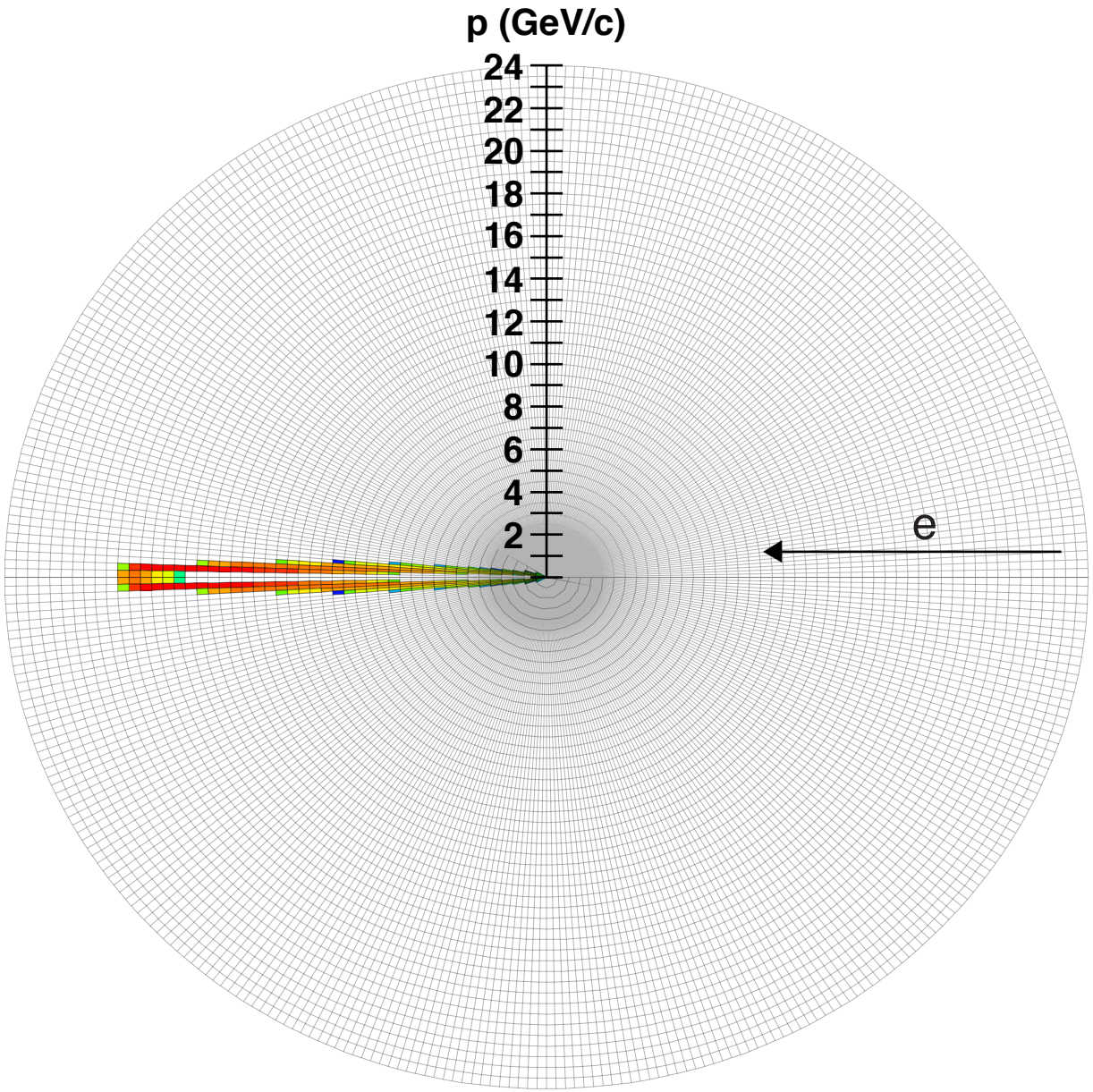
Demonstrates: The dramatic importance of the forward region

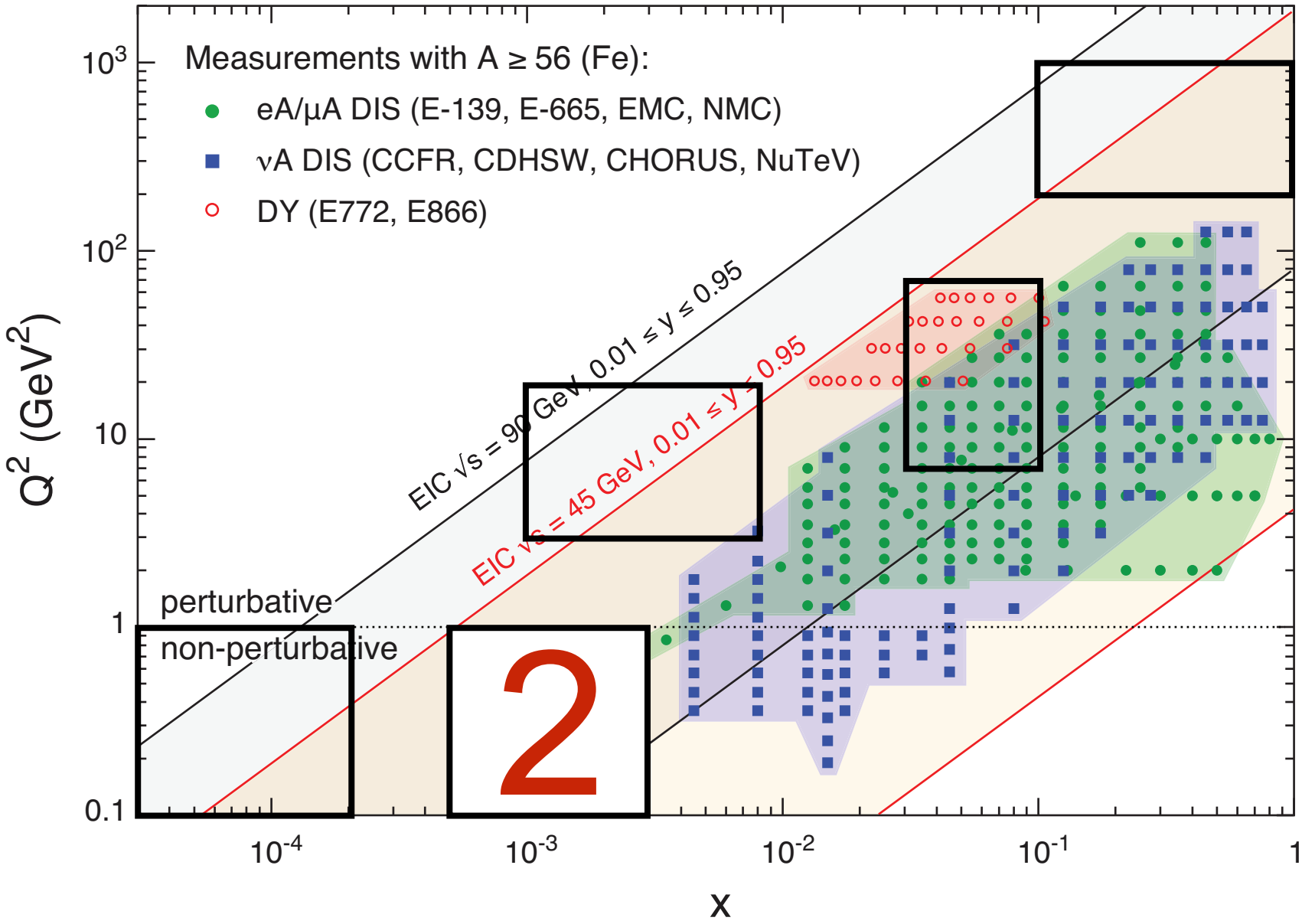

Measurements with A ≥ 56 (Fe):
eA/μA DIS (E-139, E-665, EMC, NMC)
νA DIS (CCFR, CDHSW, CHORUS, NuTeV)
DY (E772, E866)
EIC √s = 90 GeV, 0.01 ≤ y ≤ 0.95
EIC √s = 45 GeV, 0.01 ≤ y ≤ 0.95
perturbative
non-perturbative
Q² (GeV²)
x
10³
10²
10
1
0.1
10⁻⁴
10⁻³
10⁻²
10⁻¹
1


Measurements with A ≥ 56 (Fe):
eA/μA DIS (E-139, E-665, EMC, NMC)
νA DIS (CCFR, CDHSW, CHORUS, NuTeV)
DY (E772, E866)
EIC √s = 90 GeV, 0.01 ≤ y ≤ 0.95
EIC √s = 45 GeV, 0.01 ≤ y ≤ 0.95
perturbative
non-perturbative
Q² (GeV²)
x
10³
10²
10
1
0.1
10⁻⁴
10⁻³
10⁻²
10⁻¹
1

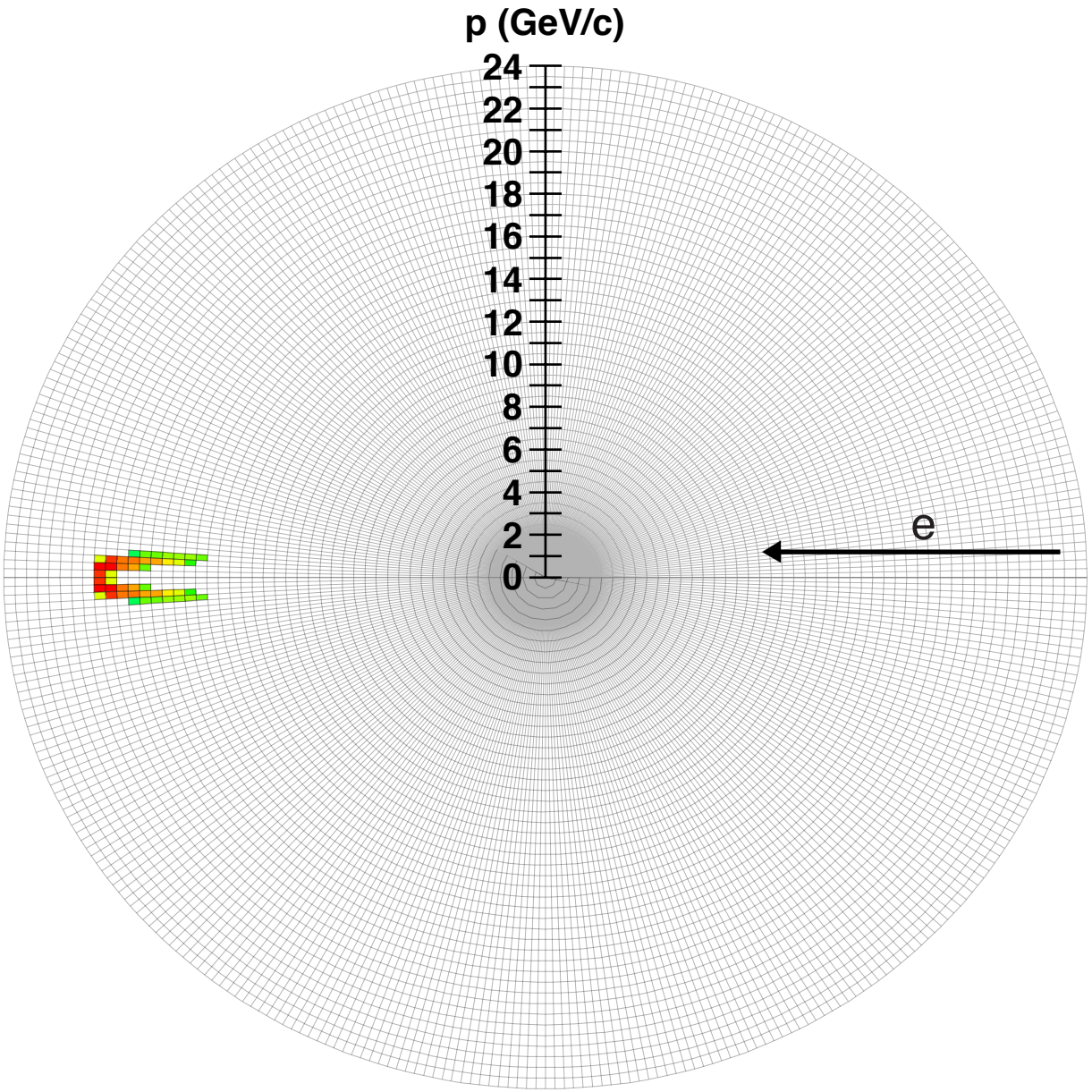

Measurements with A ≥ 56 (Fe):
eA/μA DIS (E-139, E-665, EMC, NMC)
νA DIS (CCFR, CDHSW, CHORUS, NuTeV)
DY (E772, E866)
EIC √s = 90 GeV, 0.01 ≤ y ≤ 0.95
EIC √s = 45 GeV, 0.01 ≤ y ≤ 0.95
perturbative
1
Q^2 (GeV^2)
10^3
10^2
10
1
0.1
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
x

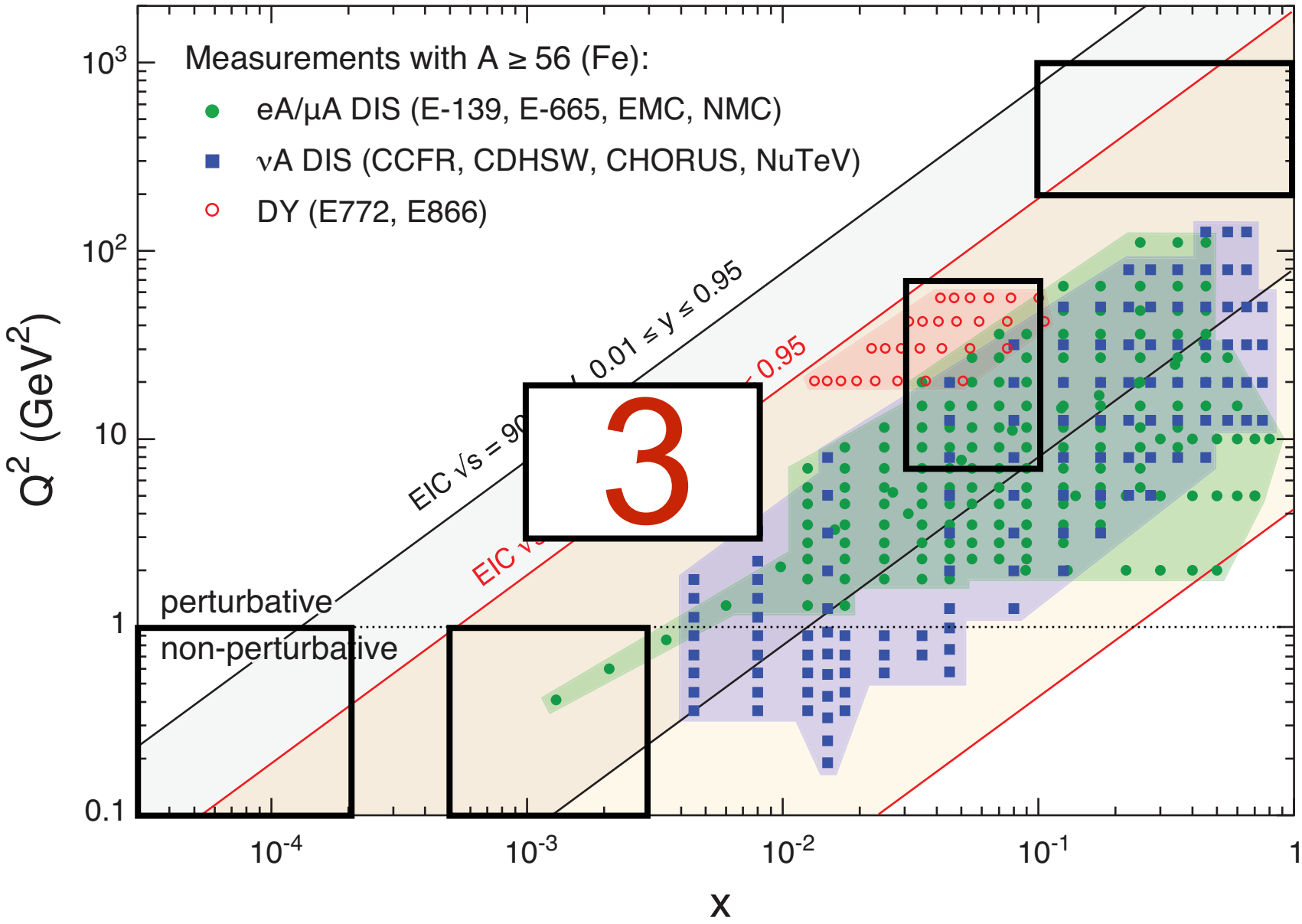
20 GeV on 100 GeV, $0.1 < Q^2 < 1\ \mathrm{GeV}^2$, $3 \cdot 10^{-5} < x < 2 \cdot 10^{-4}$



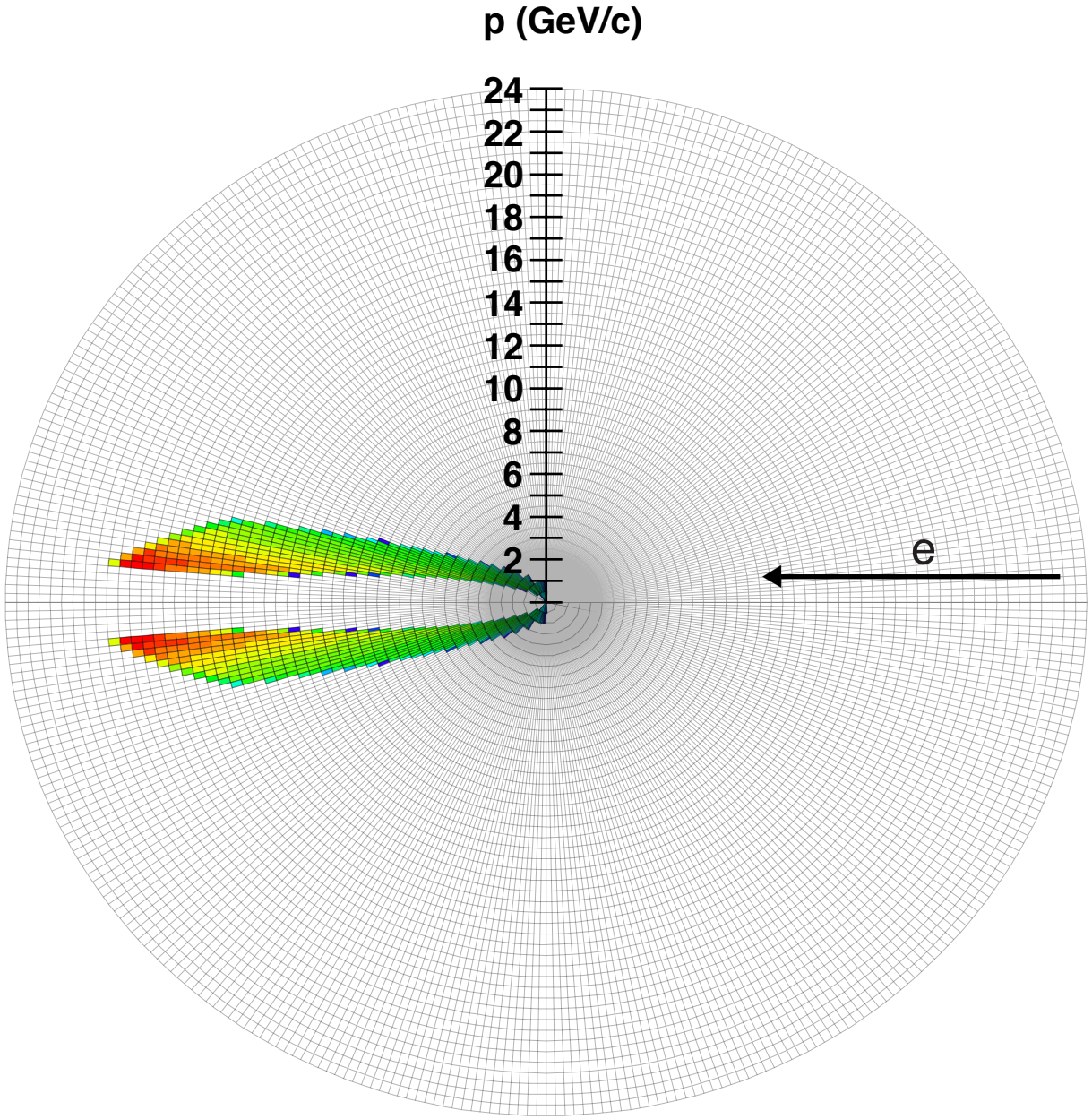

Measurements with A ≥ 56 (Fe):
eA/μA DIS (E-139, E-665, EMC, NMC)
νA DIS (CCFR, CDHSW, CHORUS, NuTeV)
DY (E772, E866)
EIC √s = 90 GeV, 0.01 ≤ y ≤ 0.95
EIC √s = 45 GeV, 0.01 ≤ y ≤ 0.95
perturbative
non-perturbative
2
Q^2 (GeV^2)
x
10^3
10^2
10
1
0.1
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1

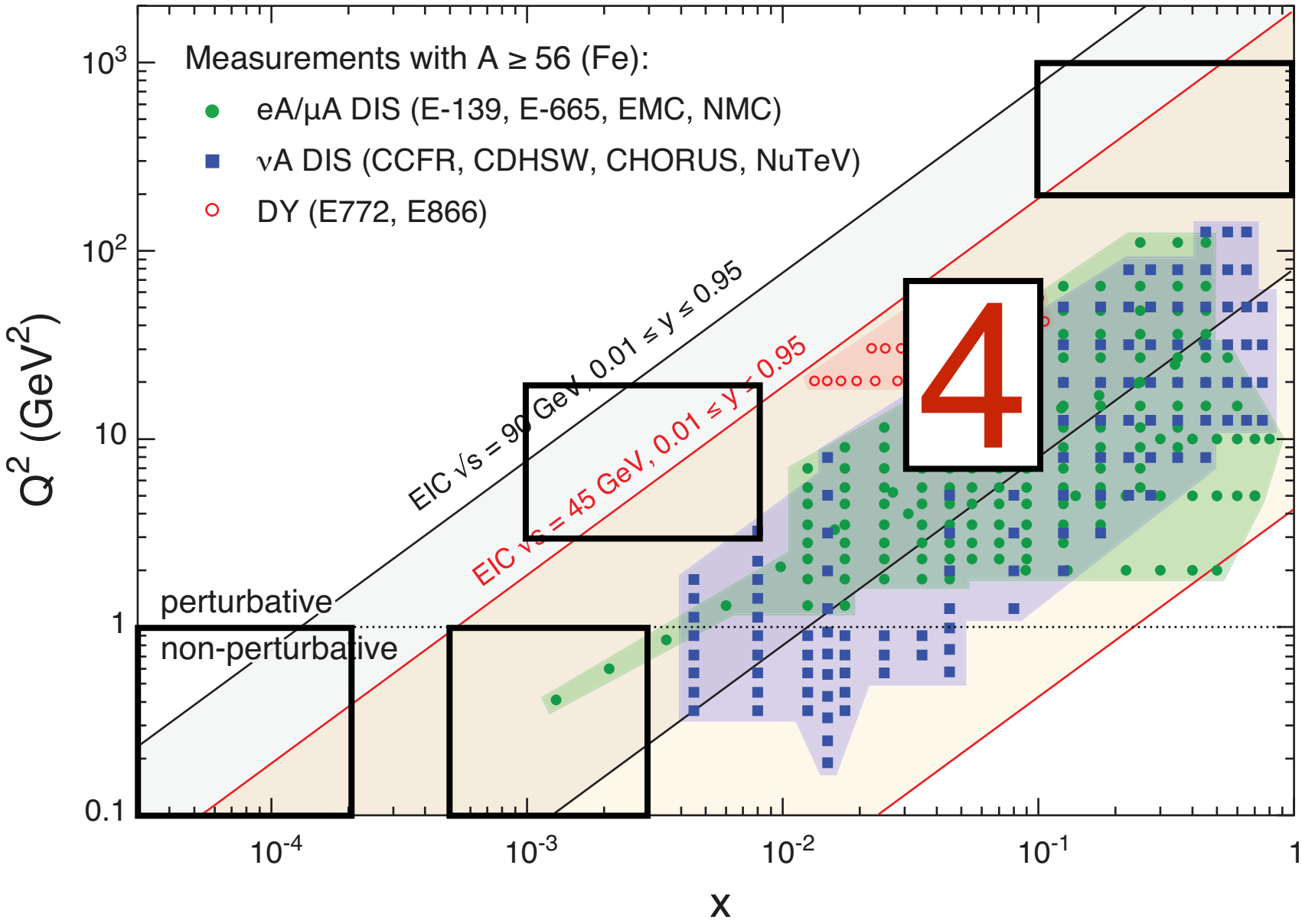
20 GeV on 100 GeV, $0.1 < Q^2 < 1\ \mathrm{GeV}^2$, $5 \cdot 10^{-4} < x < 3 \cdot 10^{-3}$



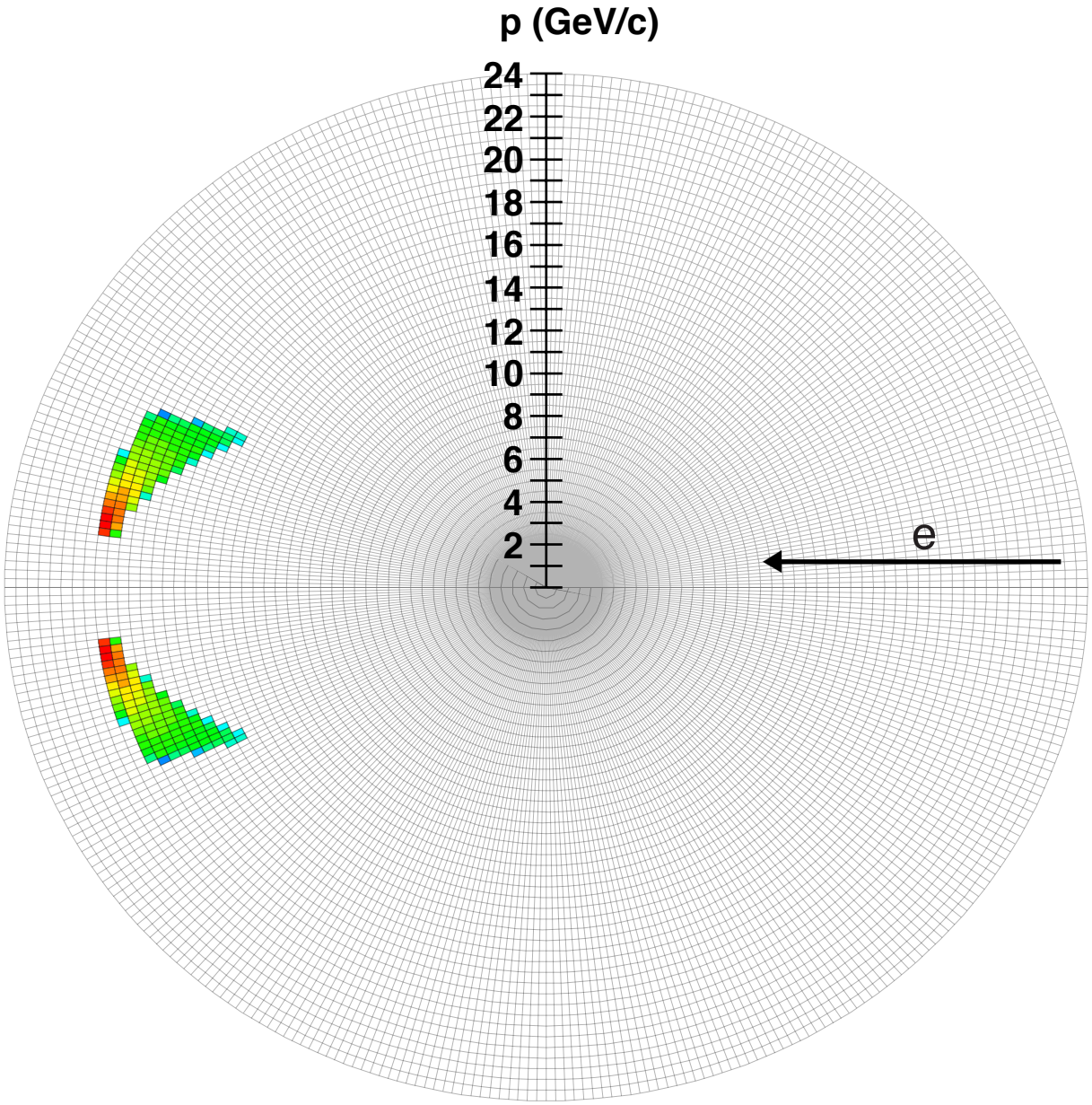

Measurements with A ≥ 56 (Fe):
eA/μA DIS (E-139, E-665, EMC, NMC)
νA DIS (CCFR, CDHSW, CHORUS, NuTeV)
DY (E772, E866)
0.01 ≤ y ≤ 0.95
EIC √s = 90
0.95
3
perturbative
non-perturbative
Q^2 (GeV^2)
x
10^3
10^2
10
1
0.1
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1

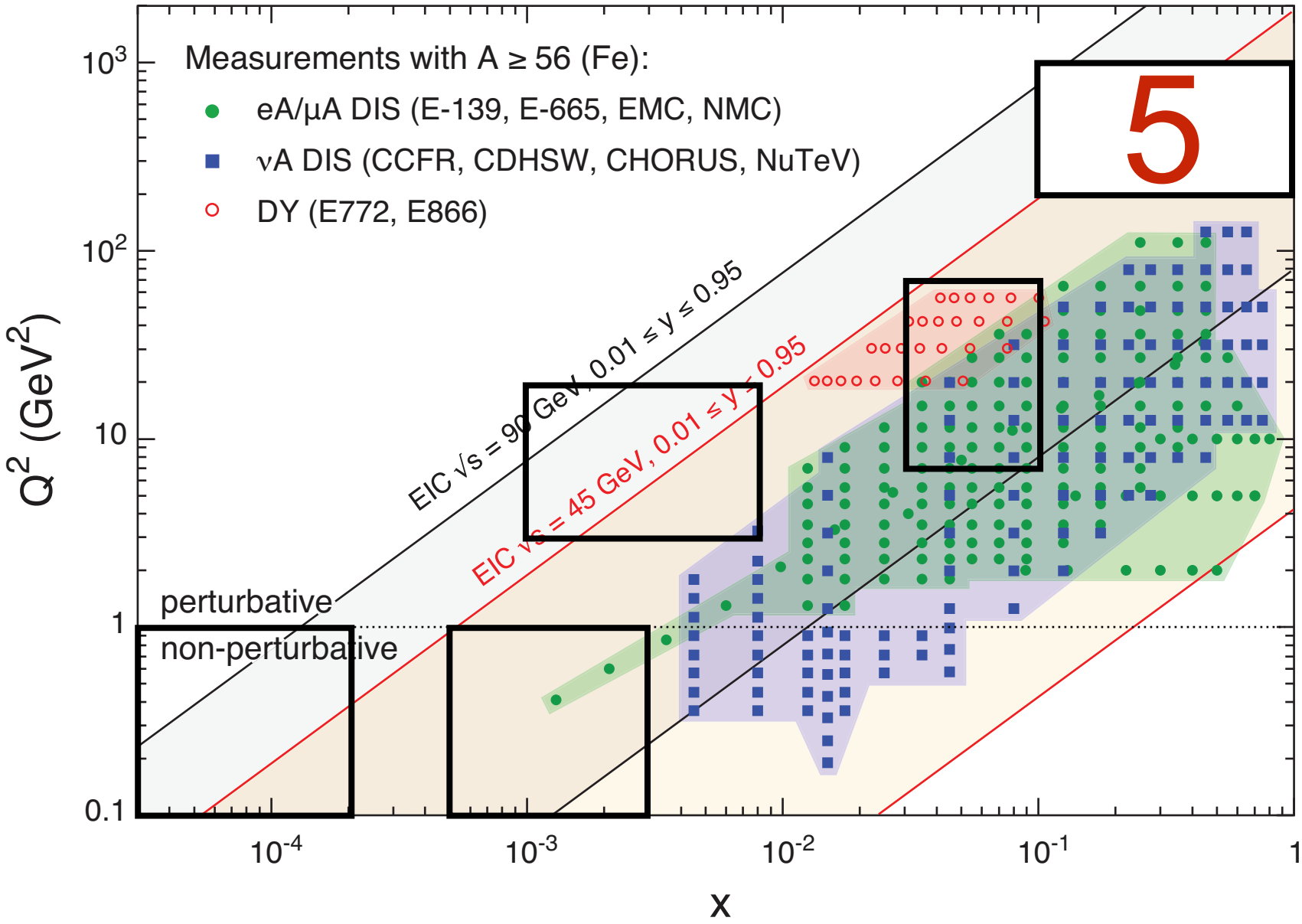
20 GeV on 100 GeV, $3 < Q^2 < 20$ GeV^2, $1 \cdot 10^{-3} < x < 8 \cdot 10^{-3}$




Measurements with A ≥ 56 (Fe):
eA/μA DIS (E-139, E-665, EMC, NMC)
νA DIS (CCFR, CDHSW, CHORUS, NuTeV)
DY (E772, E866)
EIC √s = 90 GeV, 0.01 ≤ y ≤ 0.95
EIC √s = 45 GeV, 0.01 ≤ y ≤ 0.95
4
perturbative
non-perturbative
Q^2 (GeV^2)
x
10^3
10^2
10
1
0.1
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1

20 GeV on 100 GeV, $7 < Q^2 < 70\ \mathrm{GeV}^2$, $3 \cdot 10^{-2} < x < 1 \cdot 10^{-1}$




Measurements with A ≥ 56 (Fe):
eA/μA DIS (E-139, E-665, EMC, NMC)
νA DIS (CCFR, CDHSW, CHORUS, NuTeV)
DY (E772, E866)
5
EIC √s = 90 GeV, 0.01 ≤ y ≤ 0.95
EIC √s = 45 GeV, 0.01 ≤ y ≤ 0.95
perturbative
non-perturbative
Q^2 (GeV^2)
10^3
10^2
10
1
0.1
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
x

20 GeV on 100 GeV, $200 < Q^2 < 1000\ \text{GeV}^2$, $0.1 < x < 1$